FIG. 1

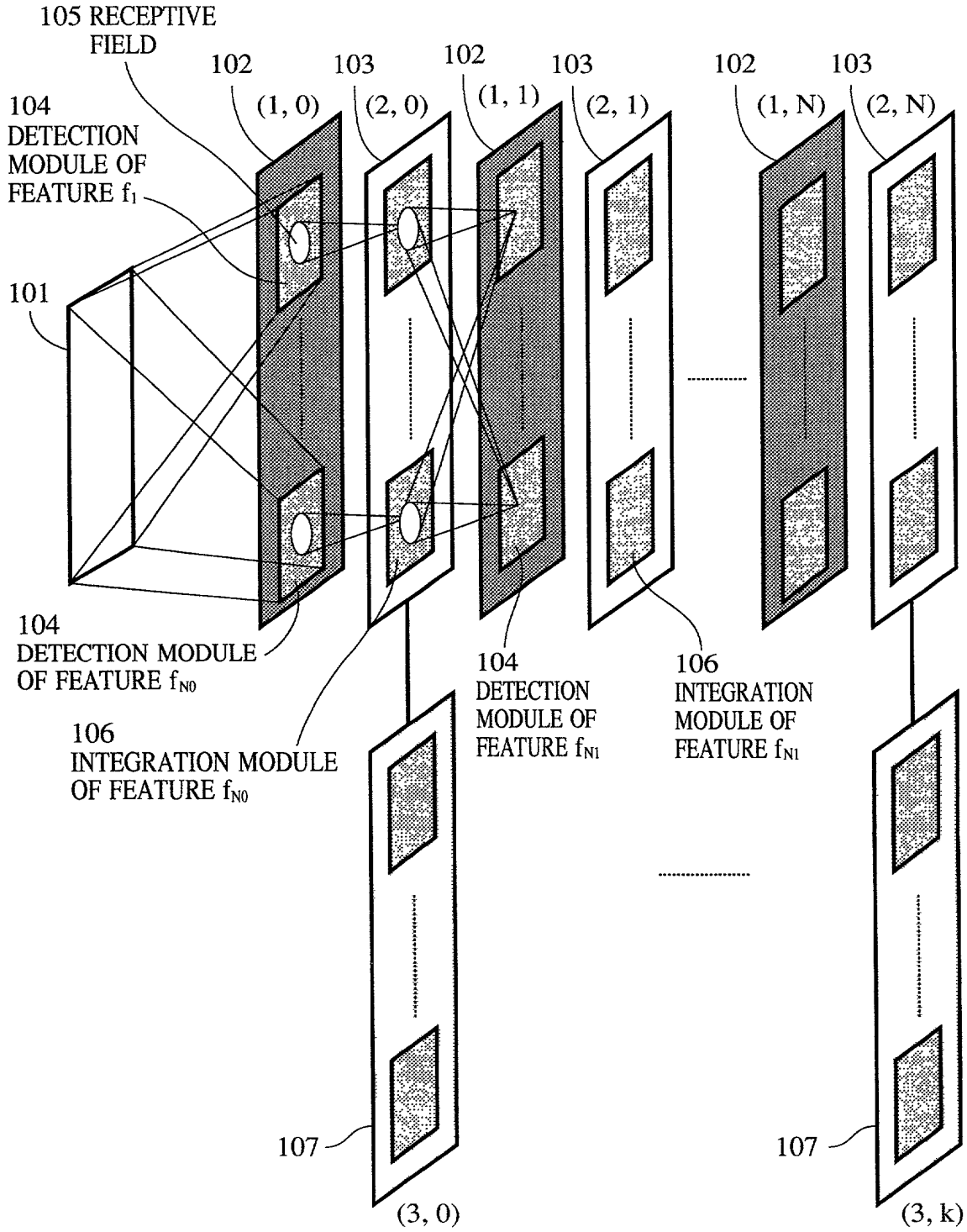
105 RECEPTIVE FIELD
102
103
102
103
102
103
104 DETECTION MODULE OF FEATURE f_1
(1, 0)
(2, 0)
(1, 1)
(2, 1)
(1, N)
(2, N)
101
104 DETECTION MODULE OF FEATURE f_{N0}
106 INTEGRATION MODULE OF FEATURE f_{N0}
104 DETECTION MODULE OF FEATURE f_{N1}
106 INTEGRATION MODULE OF FEATURE f_{N1}
107
107
(3, 0)
(3, k)

FIG. 2A

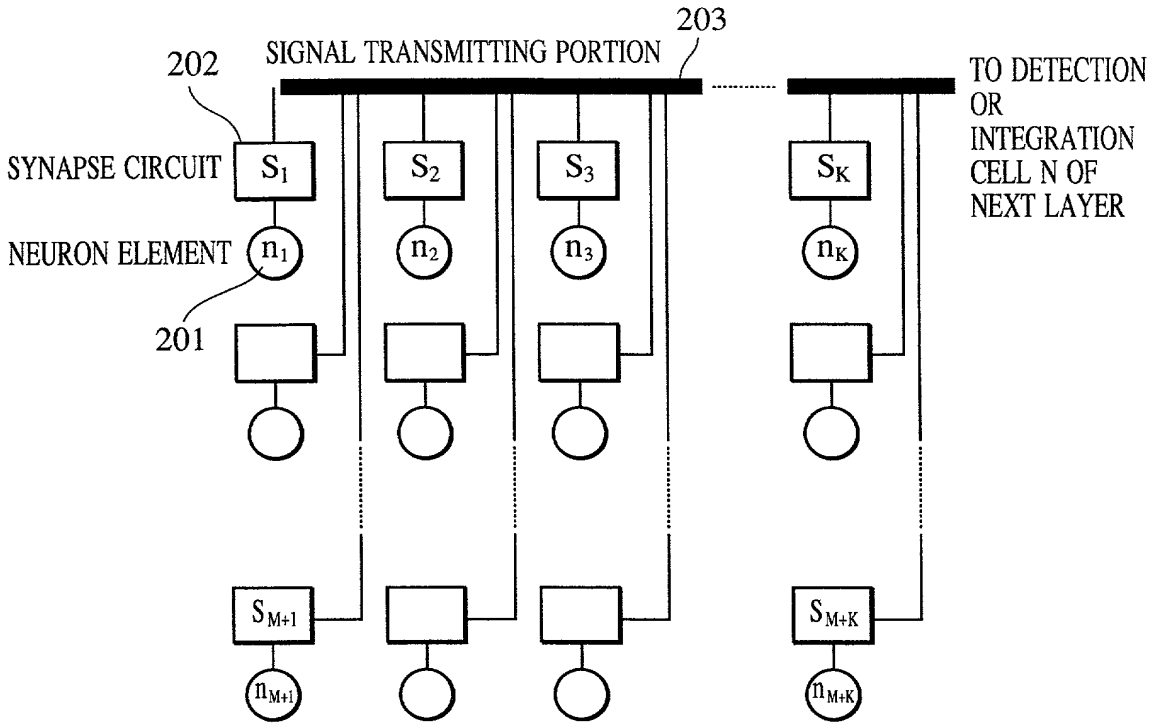

FIG. 2B

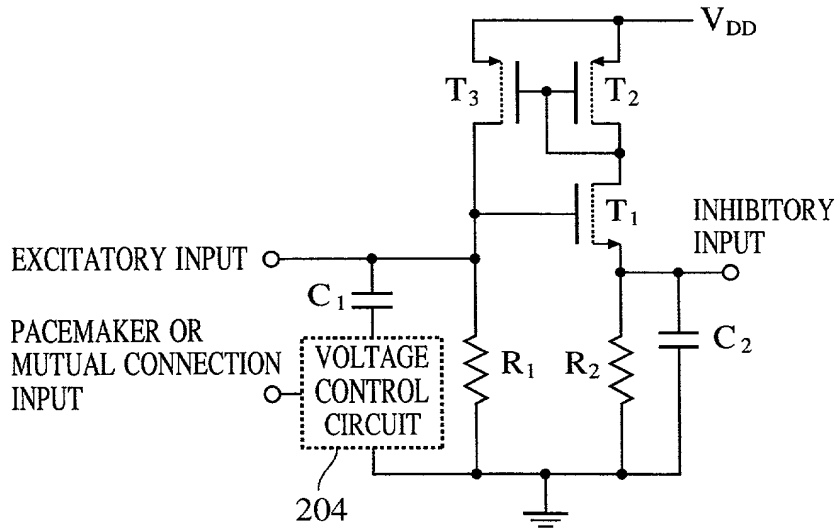

FIG. 2C

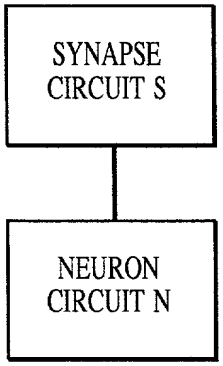

FIG. 3A

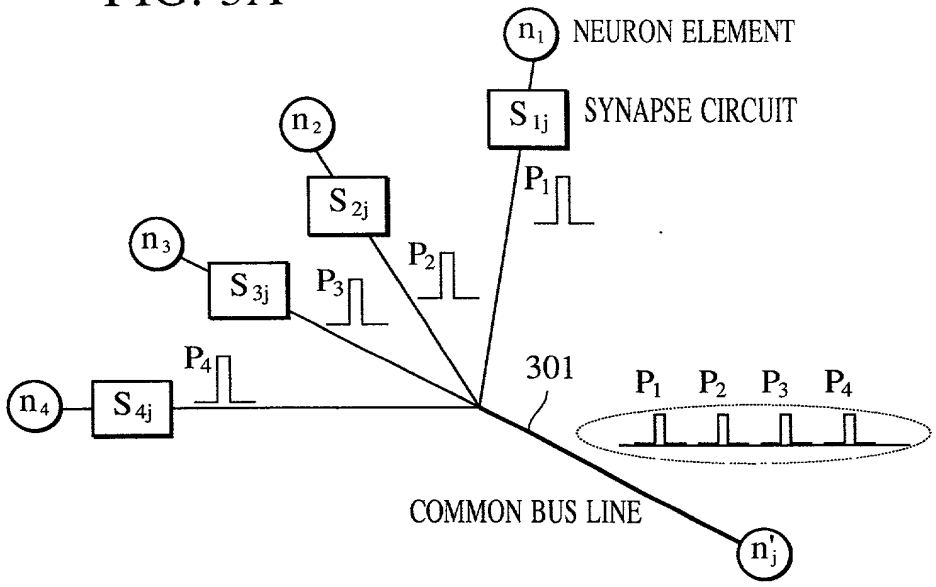
n1 NEURON ELEMENT
S1j SYNAPSE CIRCUIT
n2
S2j
n3
S3j
n4
S4j
P1
P2
P3
P4
301
P1 P2 P3 P4
COMMON BUS LINE
n'j

FIG. 3B

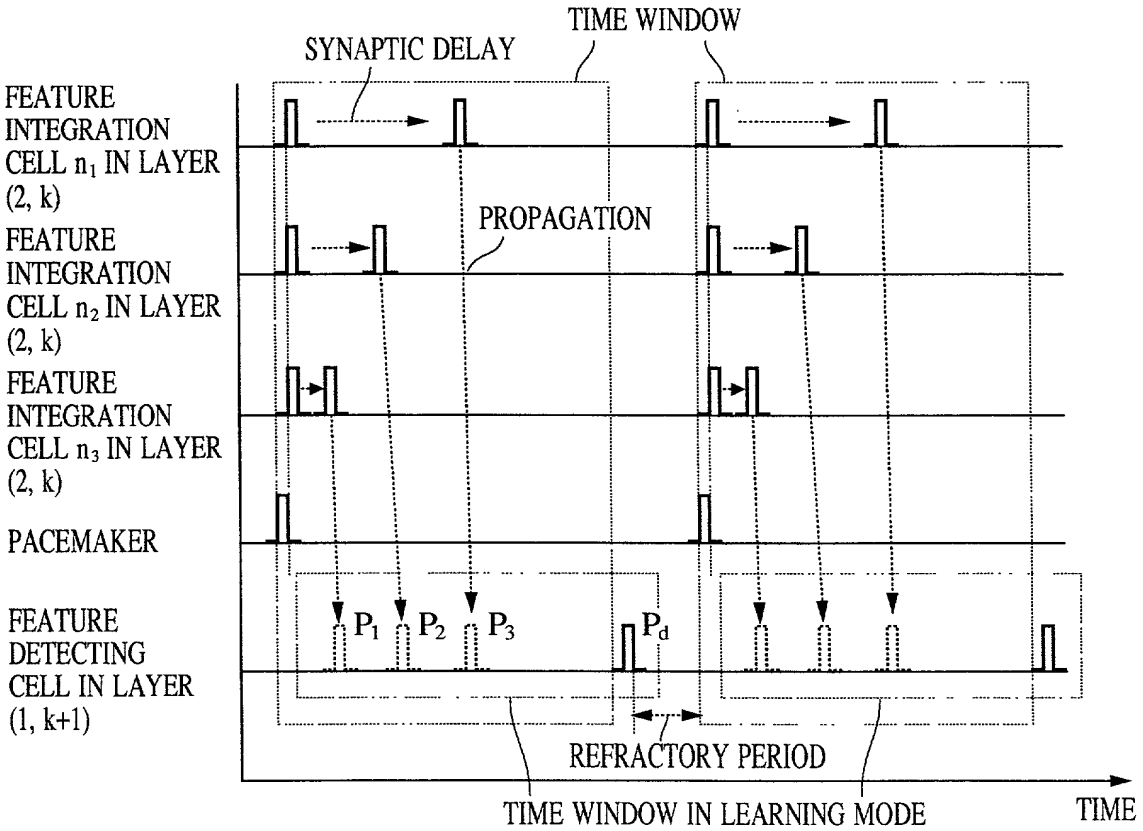
TIME WINDOW
SYNAPTIC DELAY
FEATURE INTEGRATION CELL n1 IN LAYER (2, k)
PROPAGATION
FEATURE INTEGRATION CELL n2 IN LAYER (2, k)
FEATURE INTEGRATION CELL n3 IN LAYER (2, k)
PACEMAKER
FEATURE DETECTING CELL IN LAYER (1, k+1)
P1 P2 P3 Pd
REFRACTORY PERIOD
TIME WINDOW IN LEARNING MODE
TIME

FIG. 4A

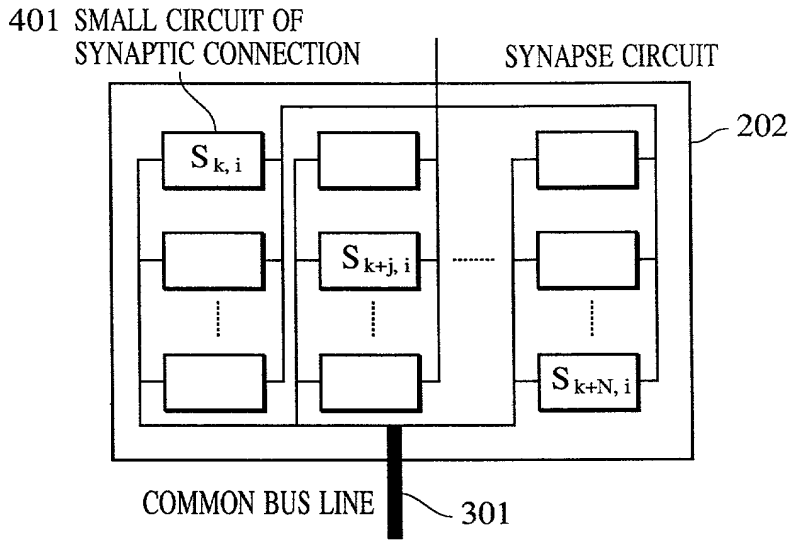

FIG. 4B

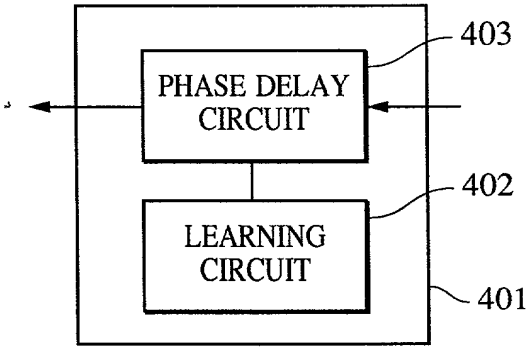

FIG. 4C

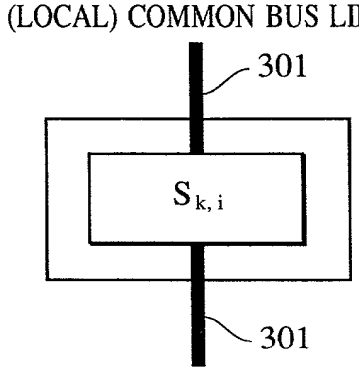

FIG. 5A

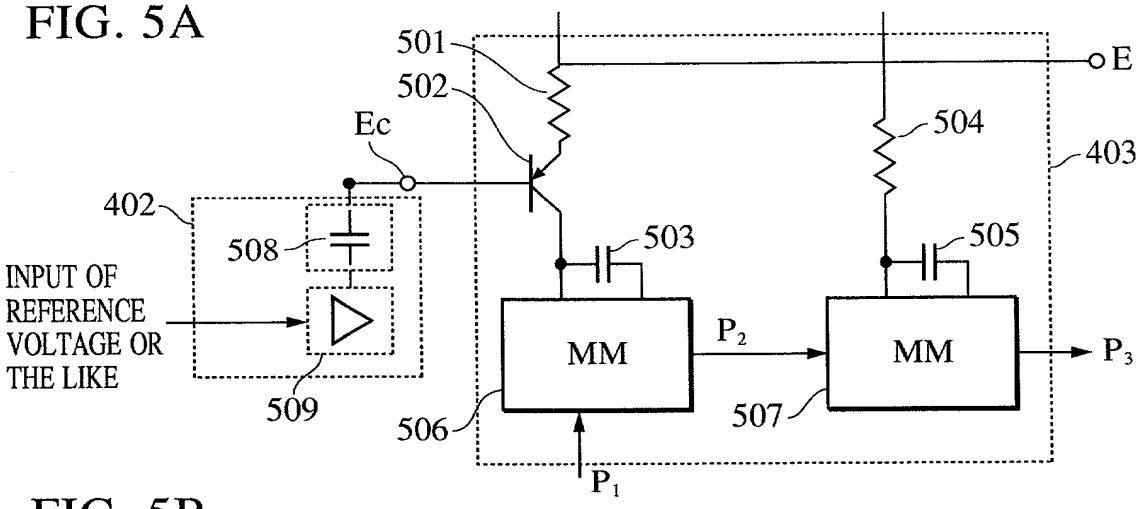

FIG. 5B

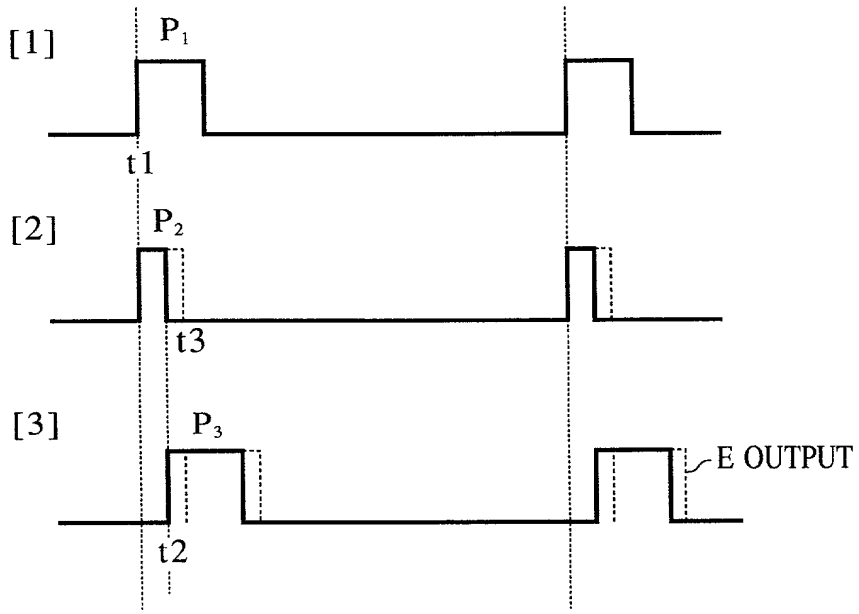

FIG. 5C

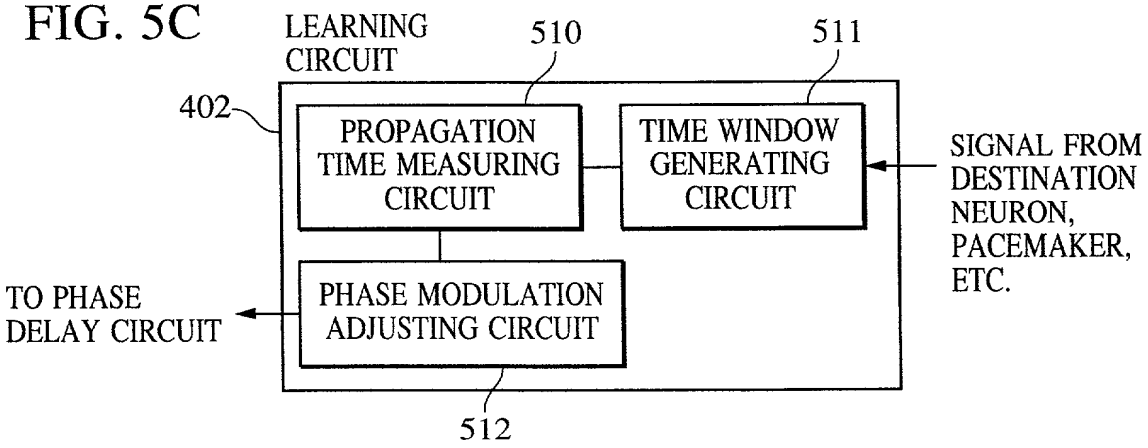

FIG. 6

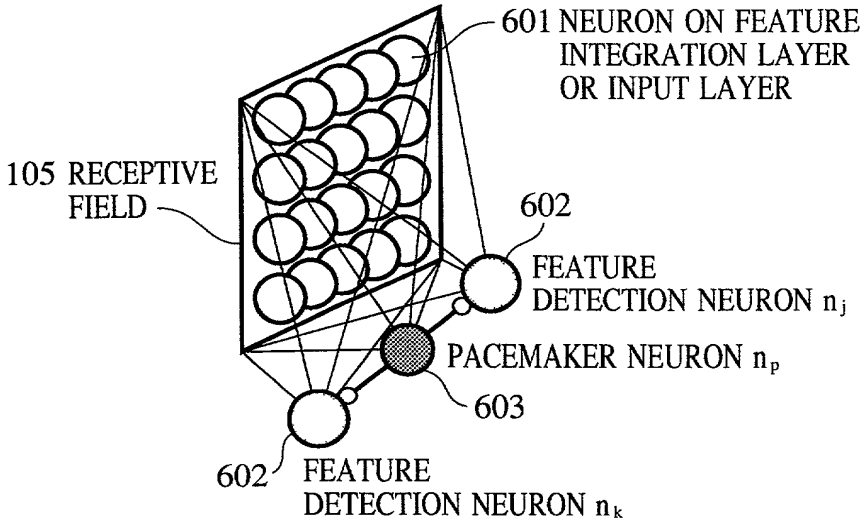
601 NEURON ON FEATURE INTEGRATION LAYER OR INPUT LAYER
105 RECEPTIVE FIELD
602
FEATURE DETECTION NEURON n_j
PACEMAKER NEURON n_p
603
602
FEATURE DETECTION NEURON n_k

FIG. 7A

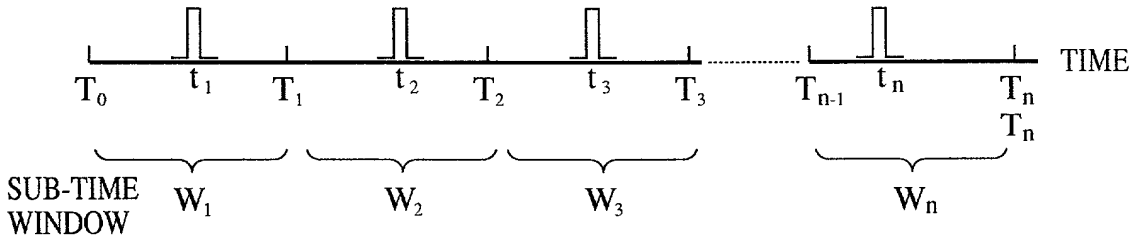

FIG. 7B

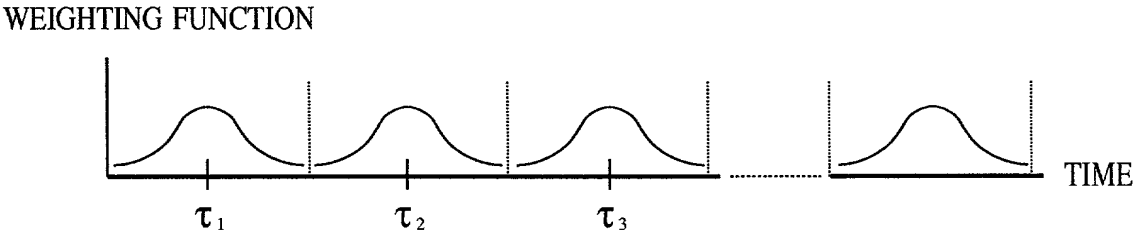

FIG. 7C

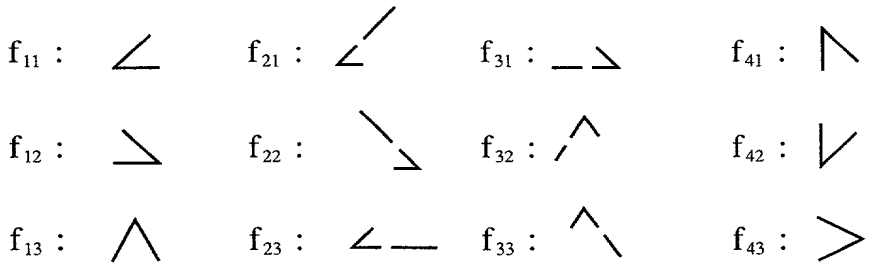

FIG. 7D

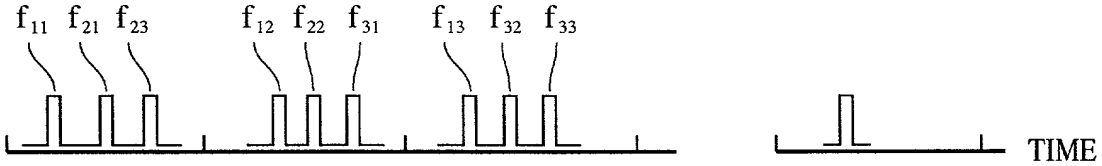

FIG. 7E

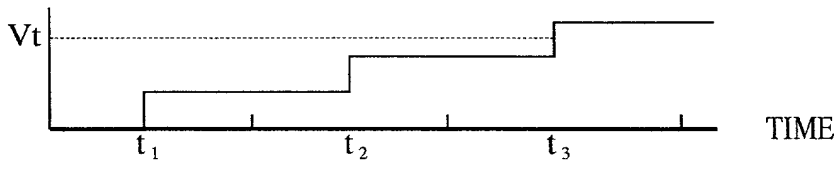

FIG. 8

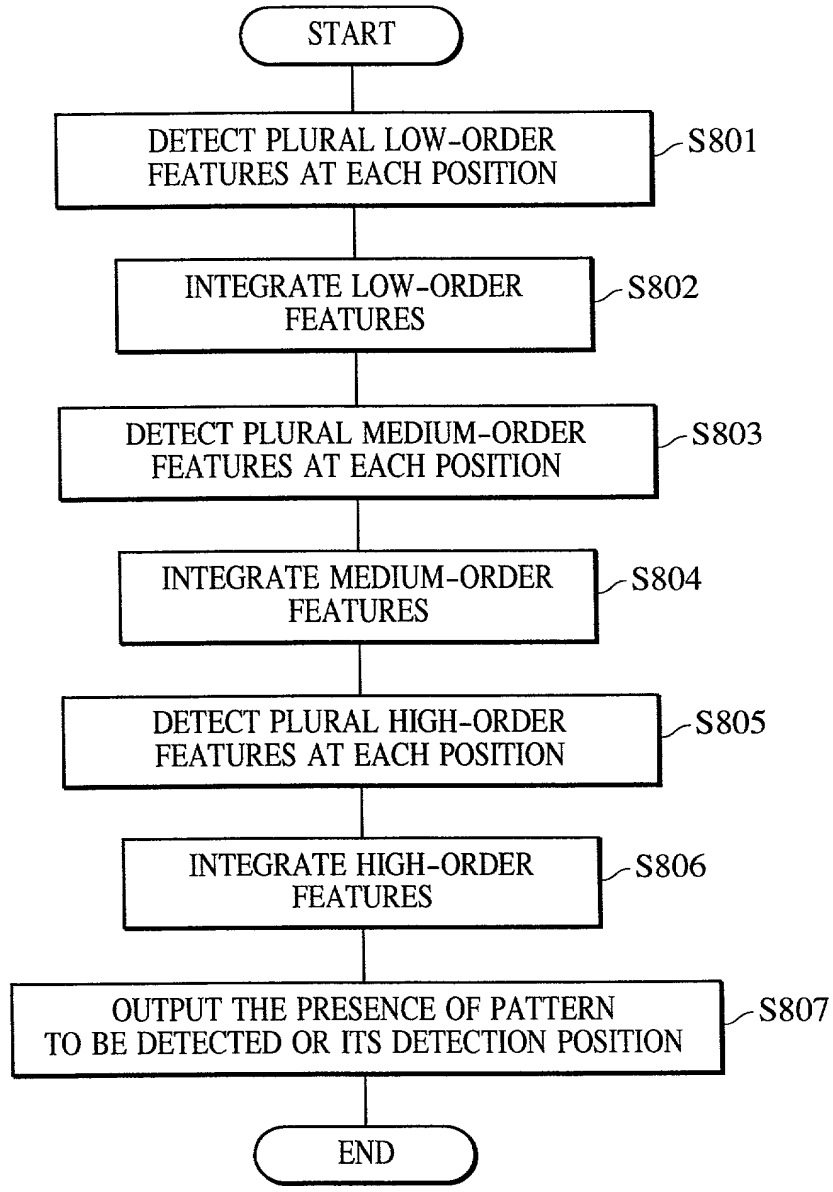

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FIG. 9

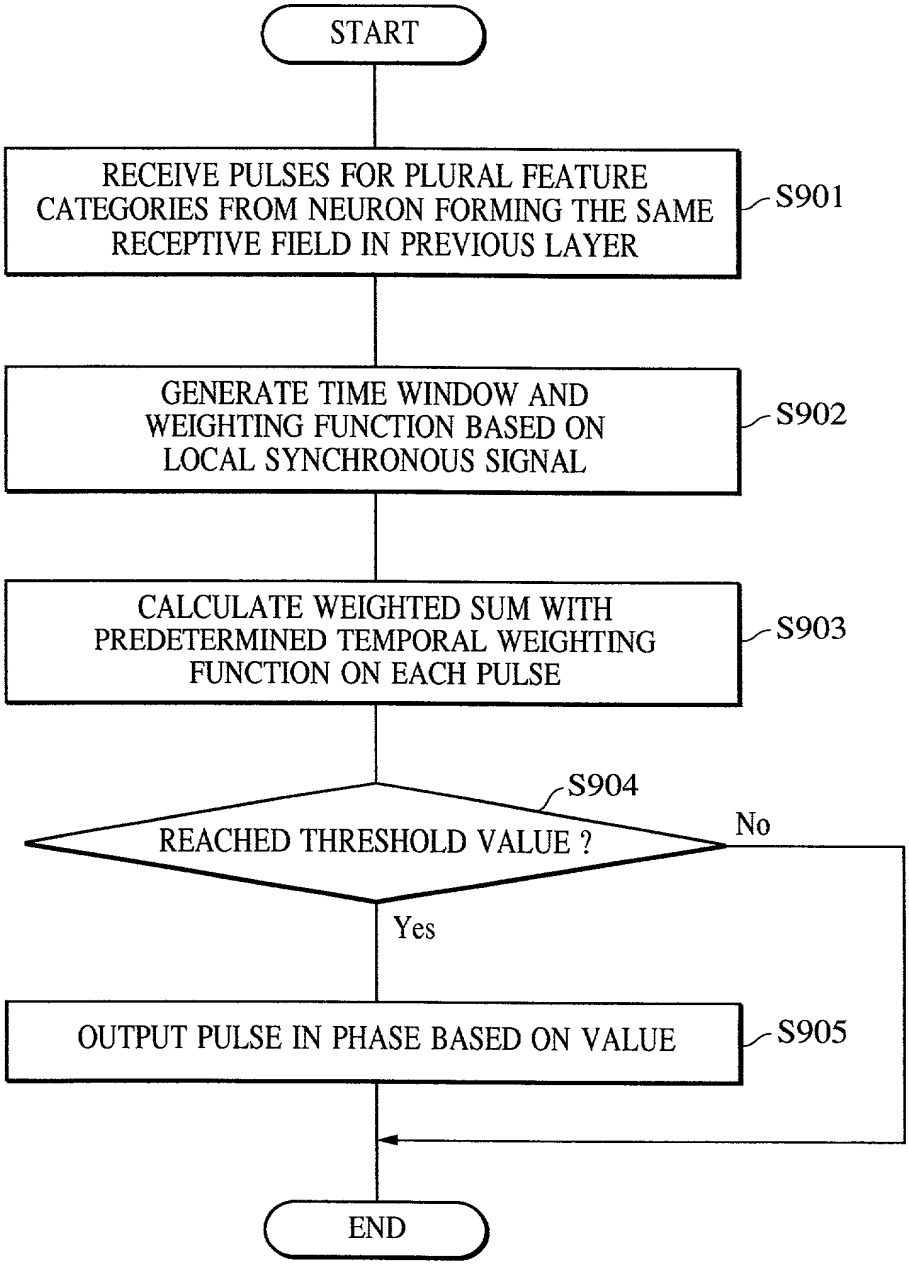

START
RECEIVE PULSES FOR PLURAL FEATURE CATEGORIES FROM NEURON FORMING THE SAME RECEPTIVE FIELD IN PREVIOUS LAYER
S901
GENERATE TIME WINDOW AND WEIGHTING FUNCTION BASED ON LOCAL SYNCHRONOUS SIGNAL
S902
CALCULATE WEIGHTED SUM WITH PREDETERMINED TEMPORAL WEIGHTING FUNCTION ON EACH PULSE
S903
S904
REACHED THRESHOLD VALUE ?
No
Yes
OUTPUT PULSE IN PHASE BASED ON VALUE
S905
END

FIG. 10

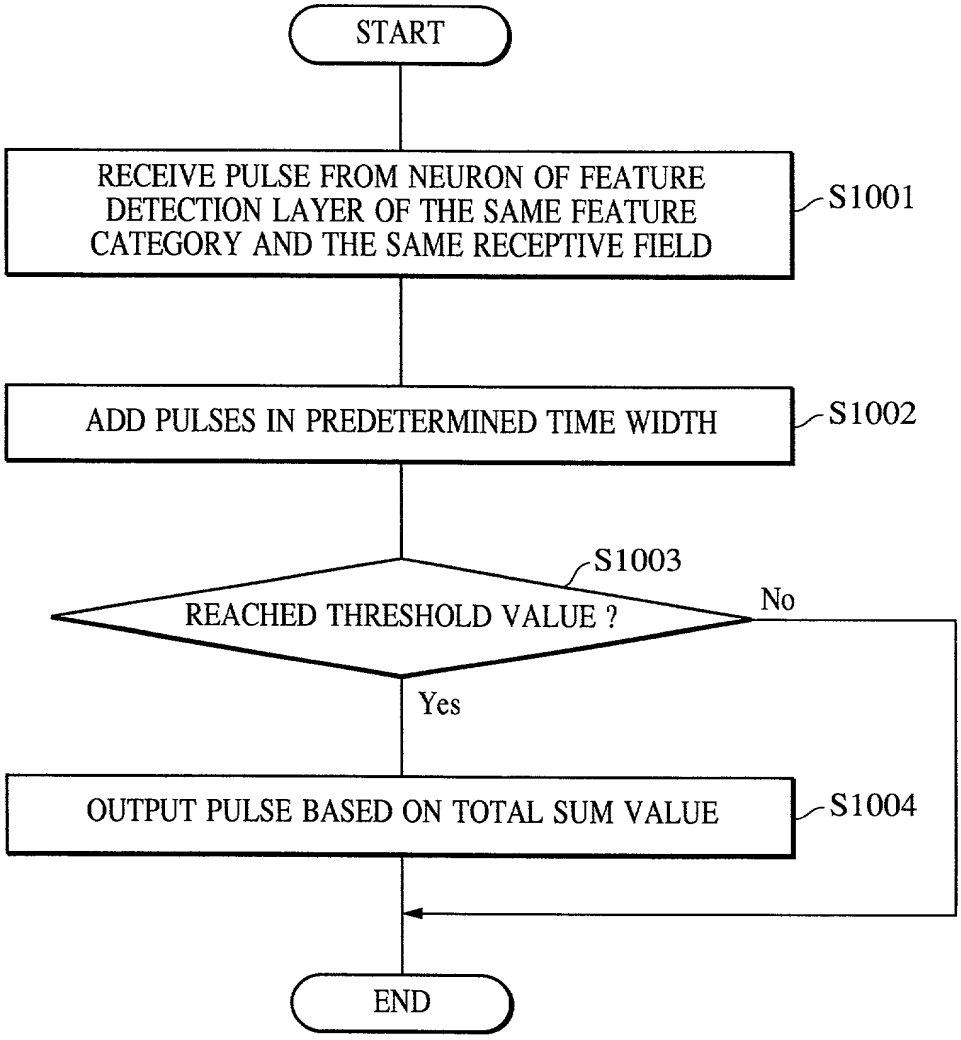

START
RECEIVE PULSE FROM NEURON OF FEATURE DETECTION LAYER OF THE SAME FEATURE CATEGORY AND THE SAME RECEPTIVE FIELD
S1001
ADD PULSES IN PREDETERMINED TIME WIDTH
S1002
S1003
REACHED THRESHOLD VALUE ?
No
Yes
OUTPUT PULSE BASED ON TOTAL SUM VALUE
S1004
END

FIG. 11

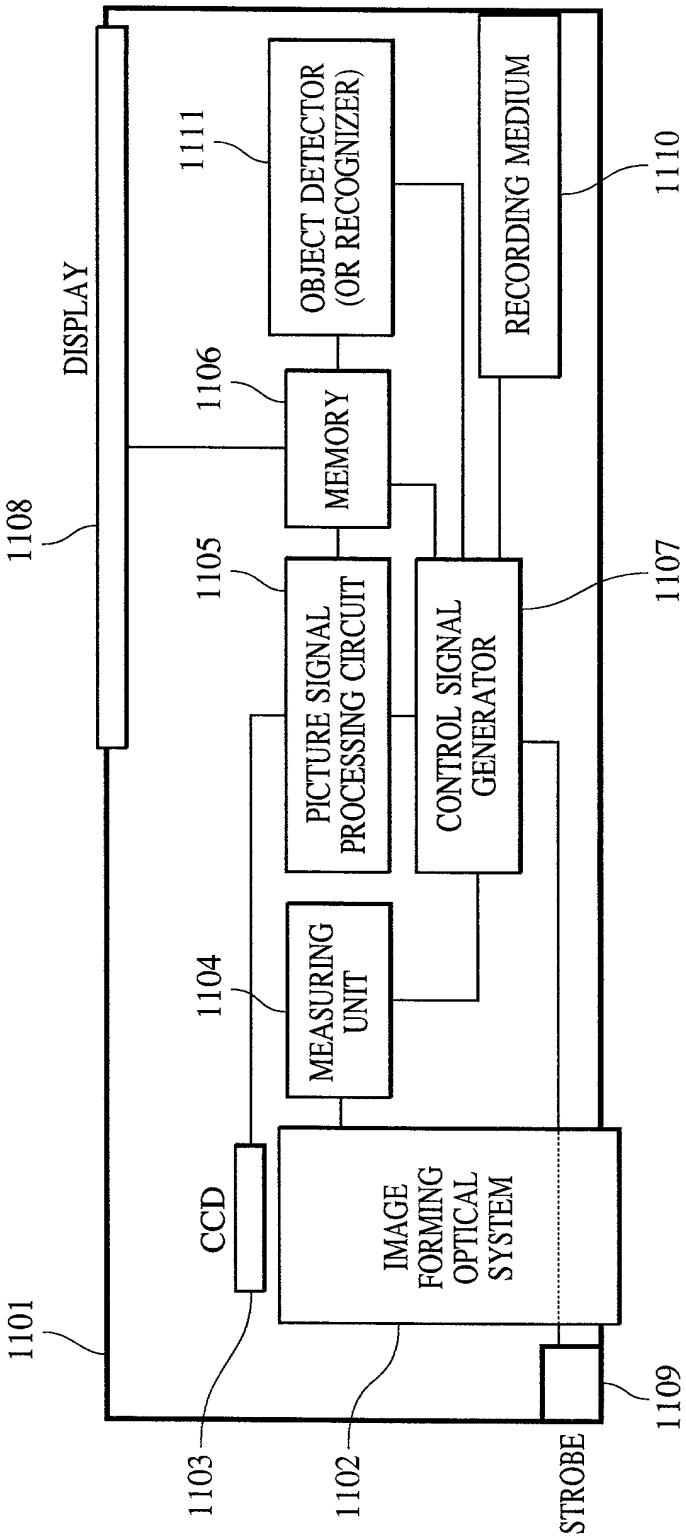

1101
CCD
1103
IMAGE FORMING OPTICAL SYSTEM
1102
STROBE
1109
1104
MEASURING UNIT
1105
PICTURE SIGNAL PROCESSING CIRCUIT
CONTROL SIGNAL GENERATOR
1107
1108
DISPLAY
1106
MEMORY
1111
OBJECT DETECTOR (OR RECOGNIZER)
RECORDING MEDIUM
1110

FIG. 12A

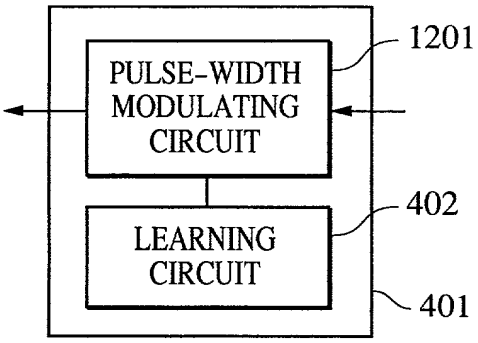


FIG. 12B

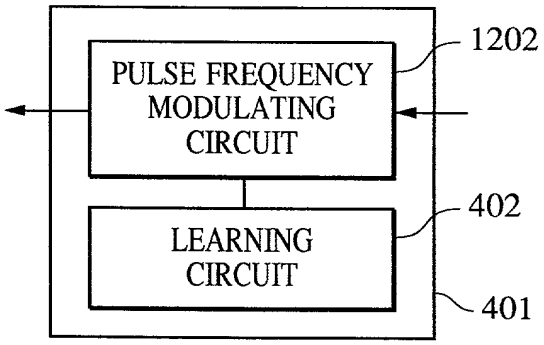


FIG. 13

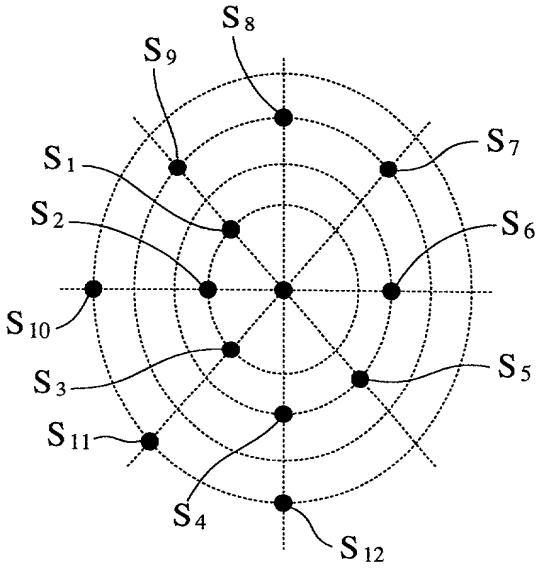
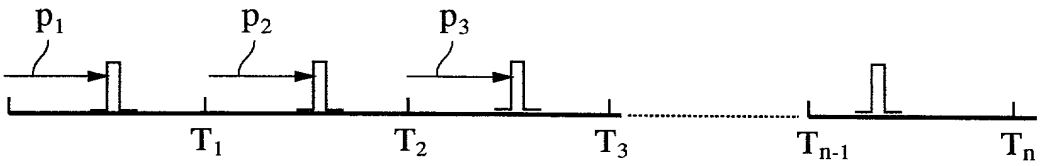


FIG. 14



SUBSTITUTE SHEET (RULE 26)

FIG. 15

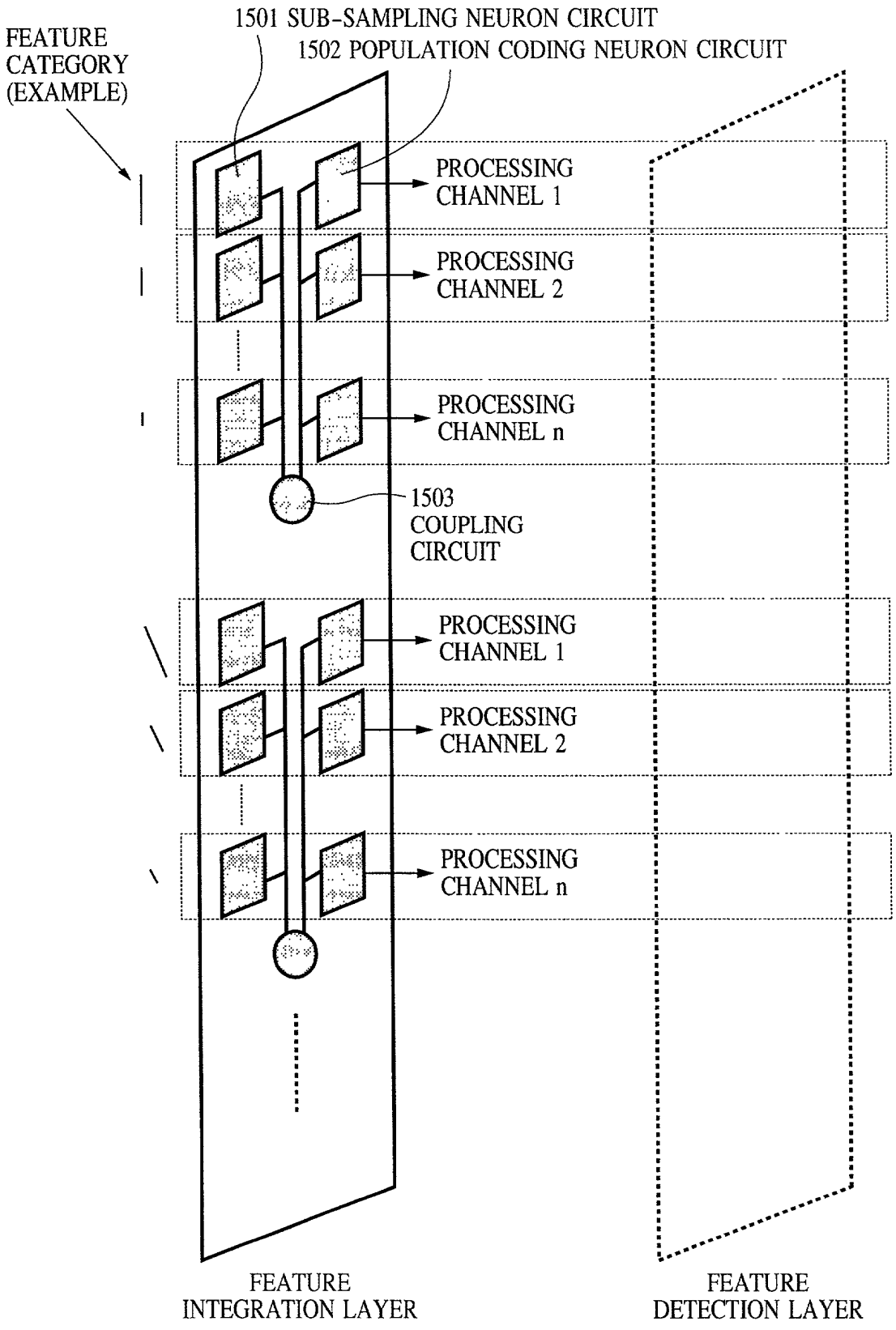


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FIG. 16

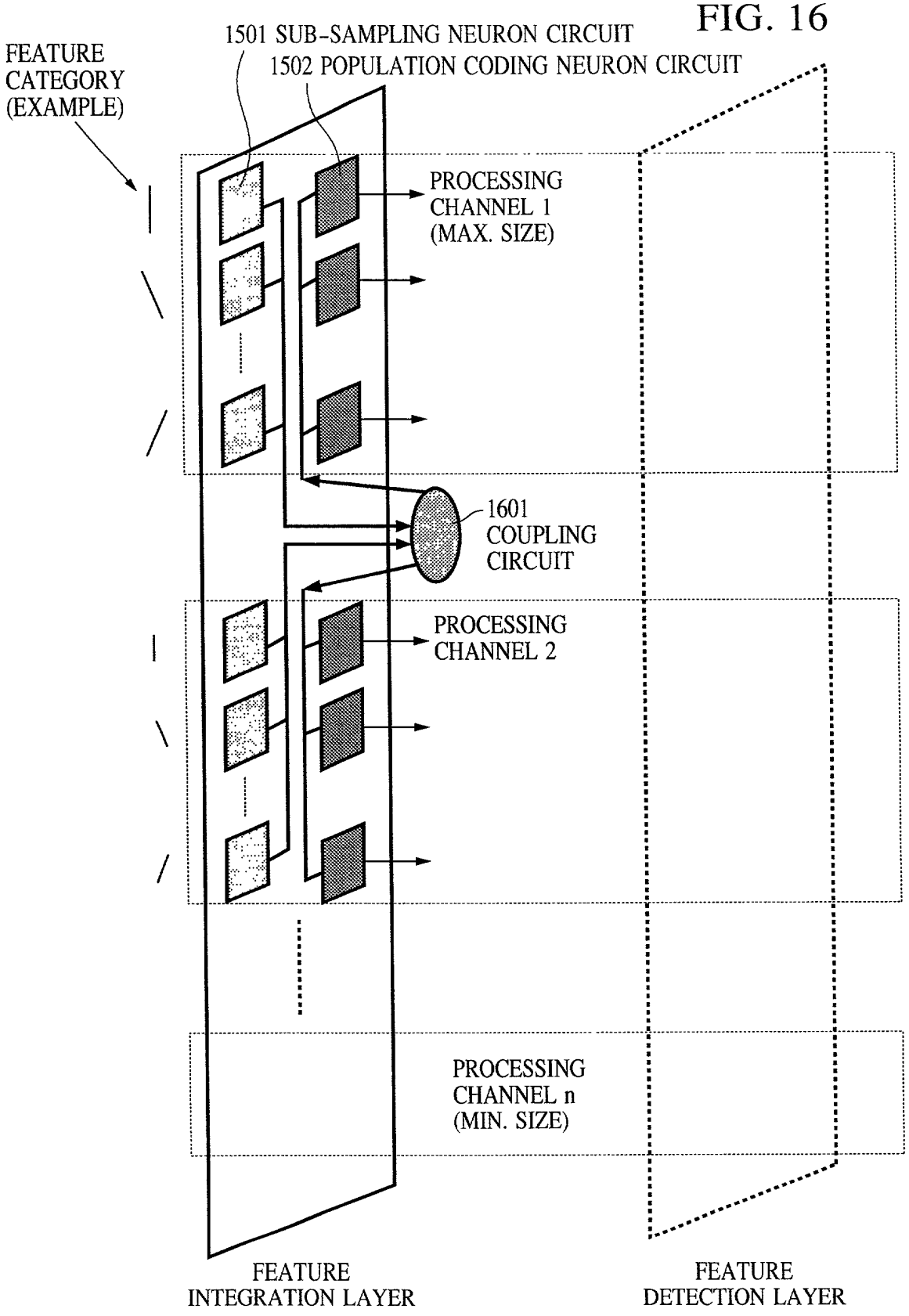

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FIG. 17

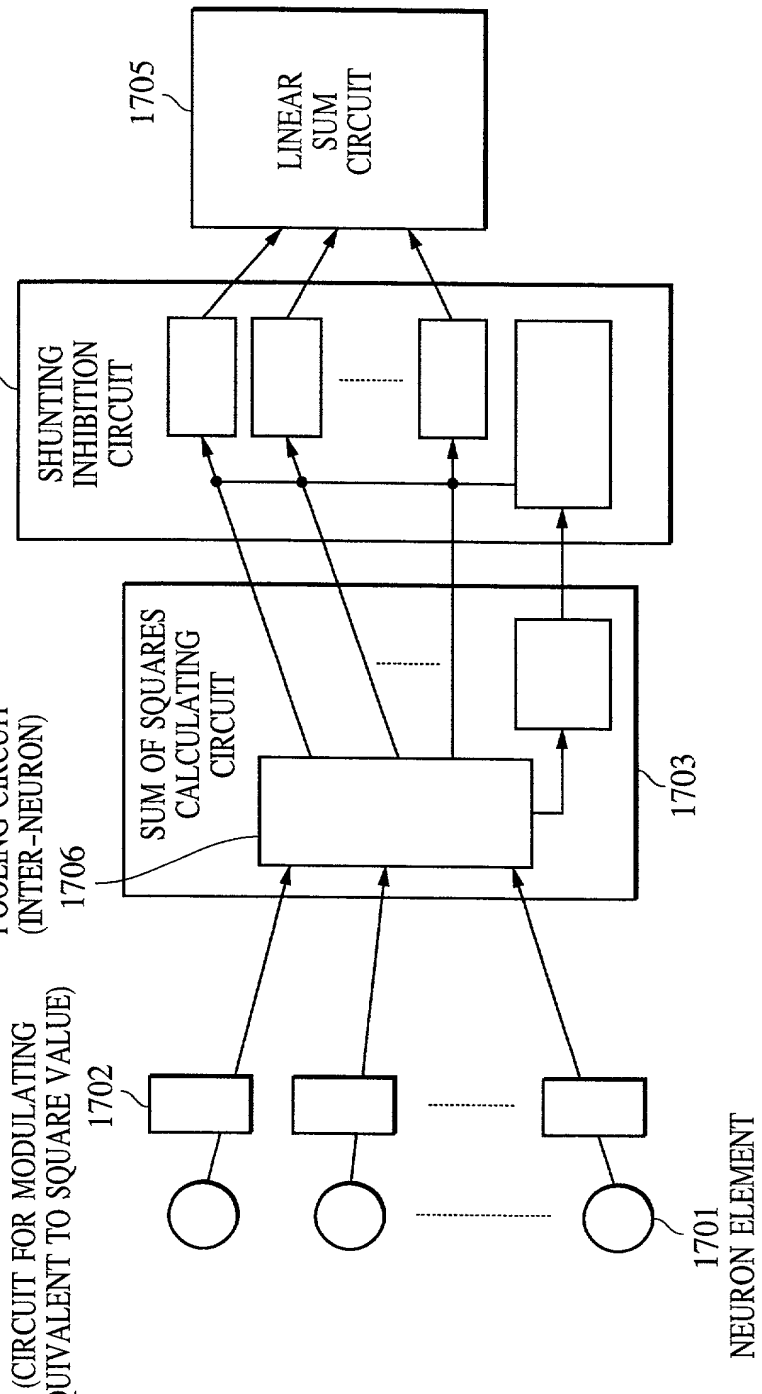
1705
LINEAR SUM CIRCUIT
1704
SHUNTING INHIBITION CIRCUIT
POOLING CIRCUIT (INTER-NEURON)
1706
SUM OF SQUARES CALCULATING CIRCUIT
1703
SYNAPSE (CIRCUIT FOR MODULATING PULSE EQUIVALENT TO SQUARE VALUE)
1702
1701
NEURON ELEMENT

FIG. 18

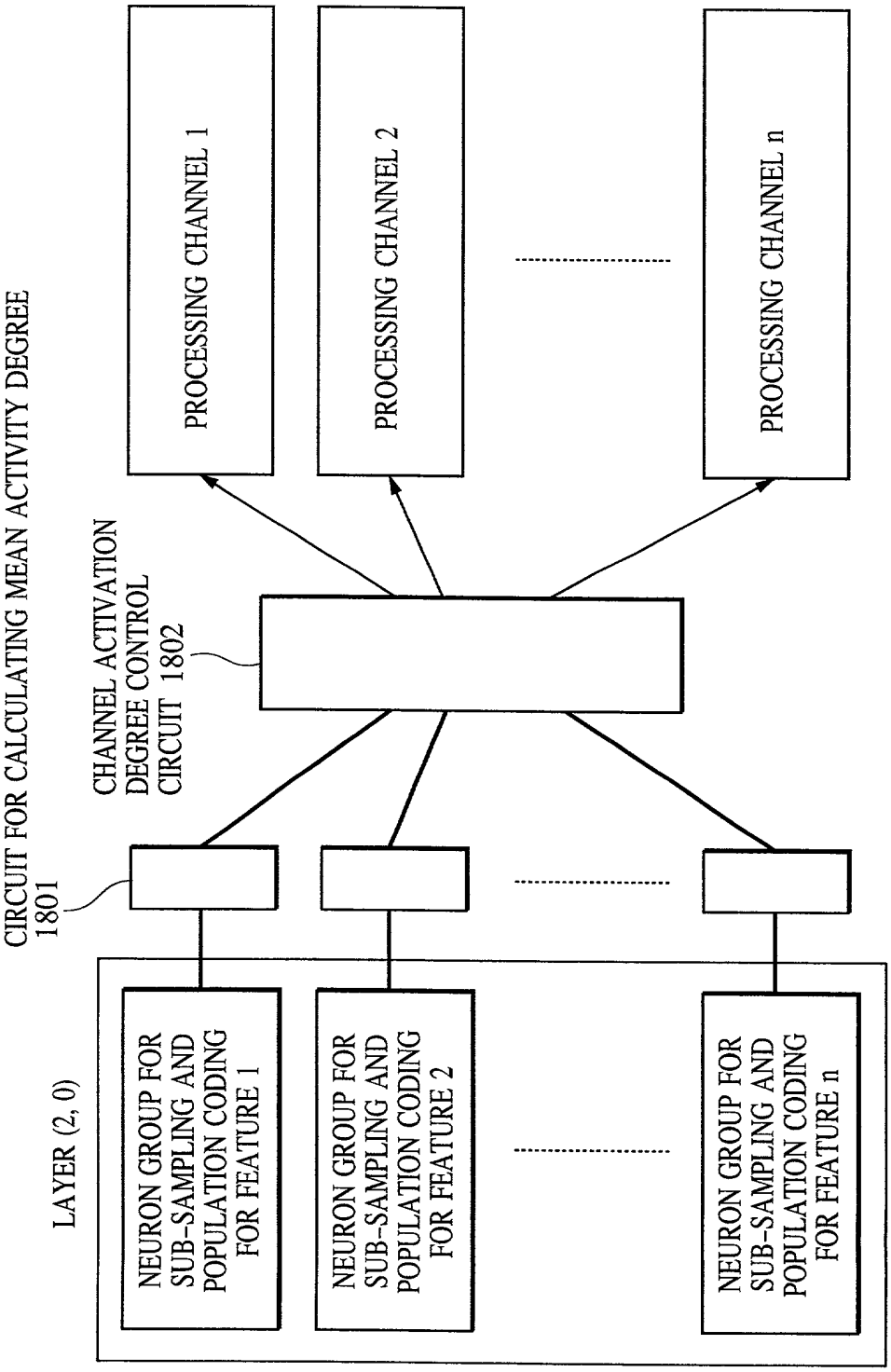
LAYER (2, 0)
NEURON GROUP FOR SUB-SAMPLING AND POPULATION CODING FOR FEATURE 1
NEURON GROUP FOR SUB-SAMPLING AND POPULATION CODING FOR FEATURE 2
NEURON GROUP FOR SUB-SAMPLING AND POPULATION CODING FOR FEATURE n
CIRCUIT FOR CALCULATING MEAN ACTIVITY DEGREE 1801
CHANNEL ACTIVATION DEGREE CONTROL CIRCUIT 1802
PROCESSING CHANNEL 1
PROCESSING CHANNEL 2
PROCESSING CHANNEL n

FIG. 19A

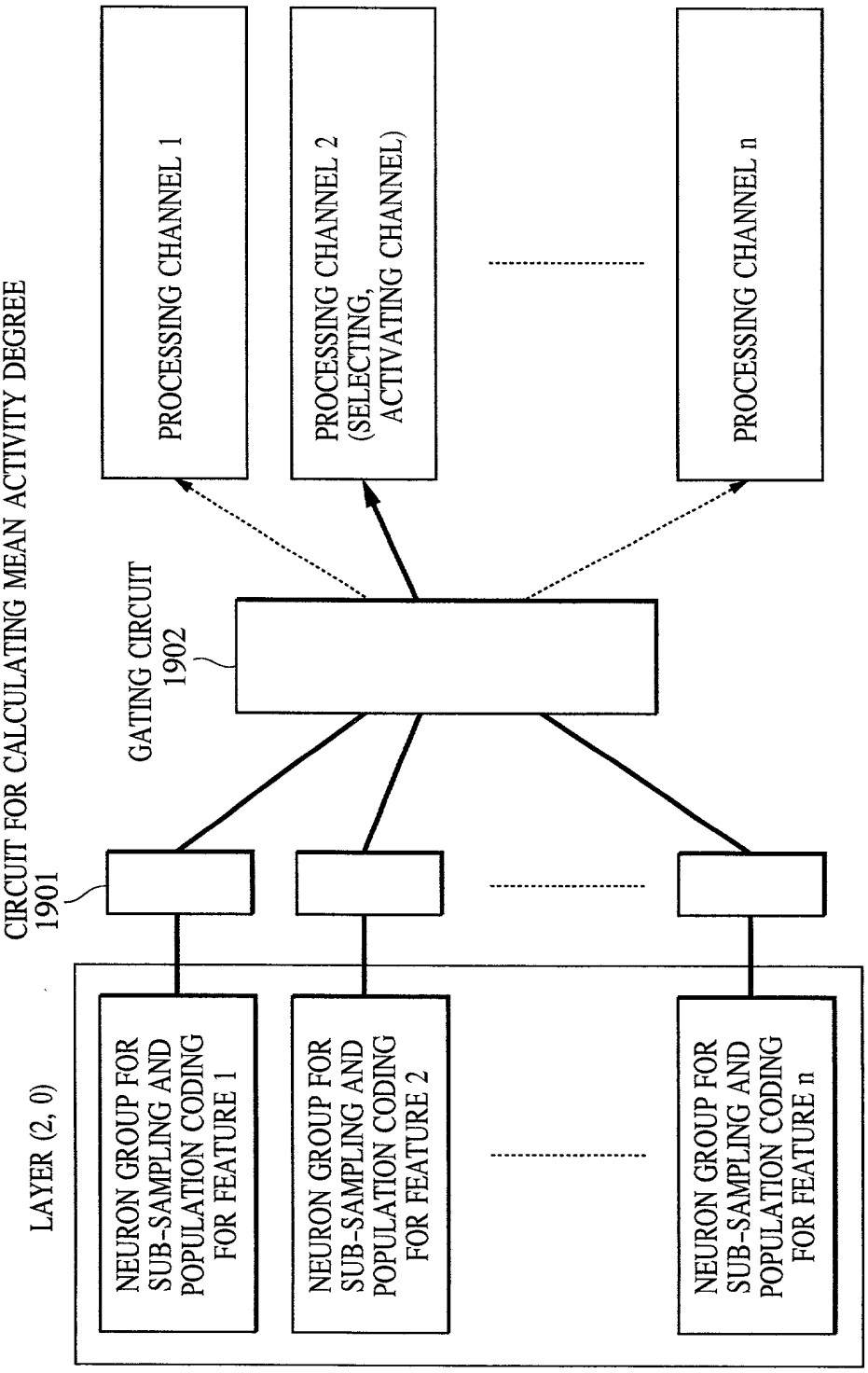
LAYER (2, 0)
NEURON GROUP FOR SUB-SAMPLING AND POPULATION CODING FOR FEATURE 1
NEURON GROUP FOR SUB-SAMPLING AND POPULATION CODING FOR FEATURE 2
NEURON GROUP FOR SUB-SAMPLING AND POPULATION CODING FOR FEATURE n
CIRCUIT FOR CALCULATING MEAN ACTIVITY DEGREE
1901
GATING CIRCUIT
1902
PROCESSING CHANNEL 1
PROCESSING CHANNEL 2 (SELECTING, ACTIVATING CHANNEL)
PROCESSING CHANNEL n

FIG. 19B

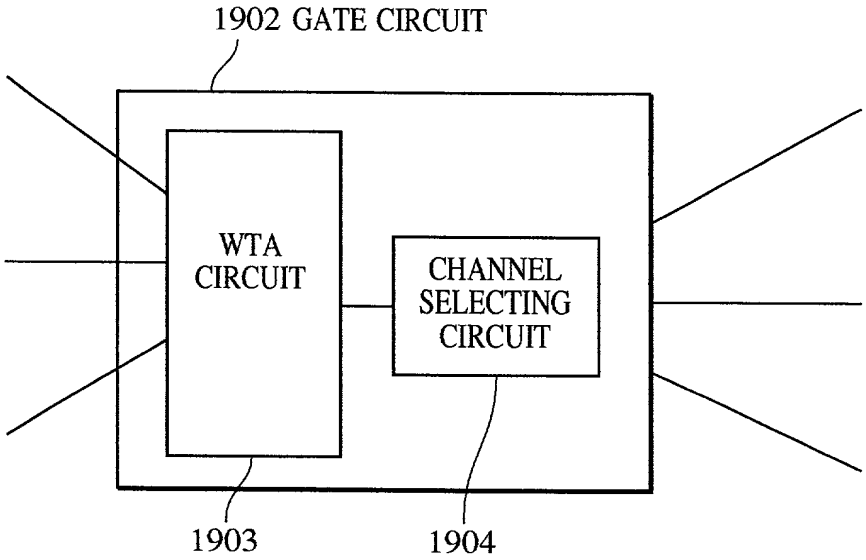

FIG. 20

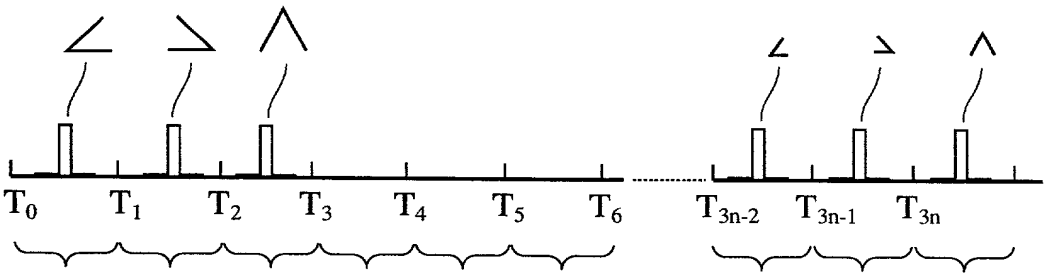

FIG. 21

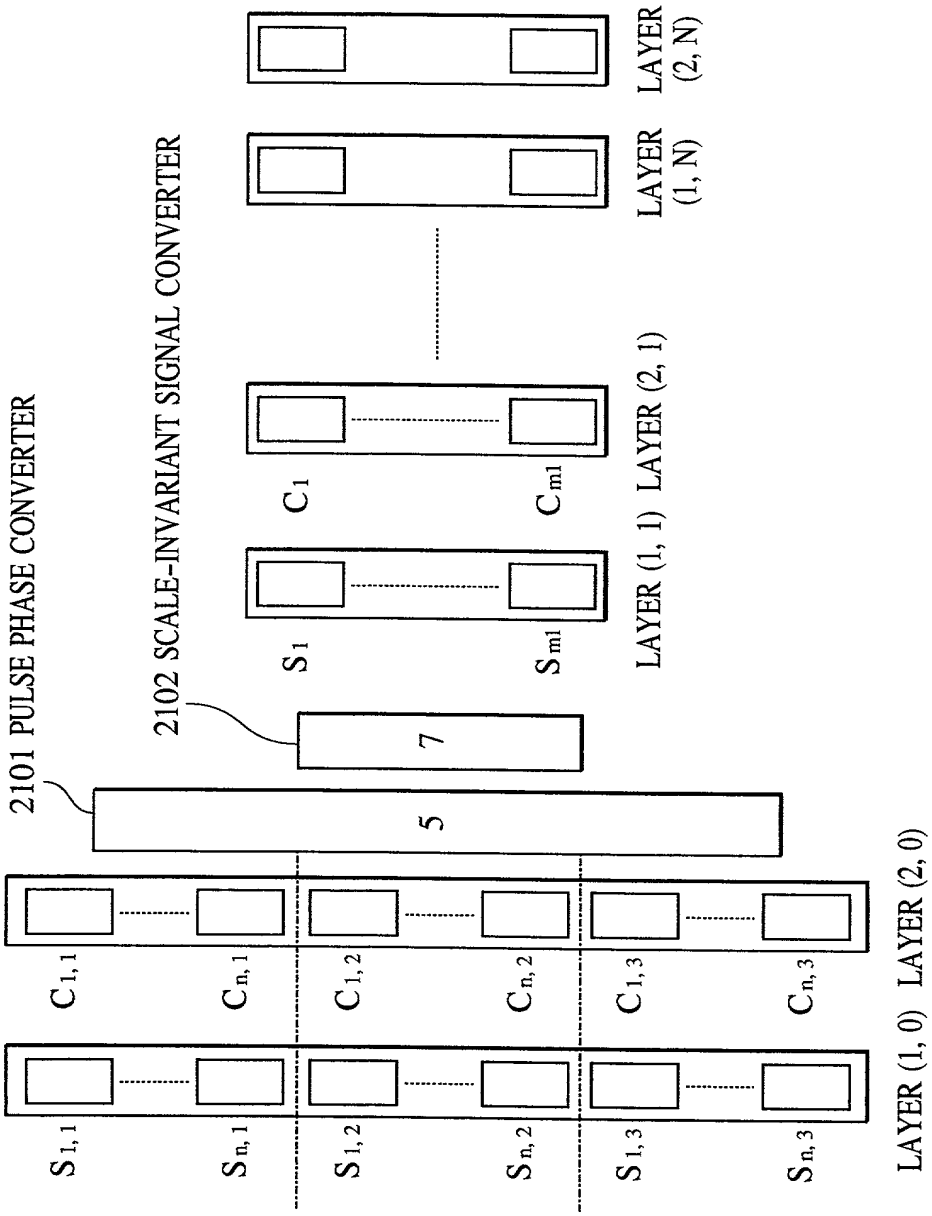
2101 PULSE PHASE CONVERTER
2102 SCALE-INVARIANT SIGNAL CONVERTER
5
7
$S_{1,1}$
$S_{n,1}$
$S_{1,2}$
$S_{n,2}$
$S_{1,3}$
$S_{n,3}$
$C_{1,1}$
$C_{n,1}$
$C_{1,2}$
$C_{n,2}$
$C_{1,3}$
$C_{n,3}$
S_1
S_{m1}
C_1
C_{m1}
LAYER (1, 0)
LAYER (2, 0)
LAYER (1, 1)
LAYER (2, 1)
LAYER (1, N)
LAYER (2, N)

FIG. 22

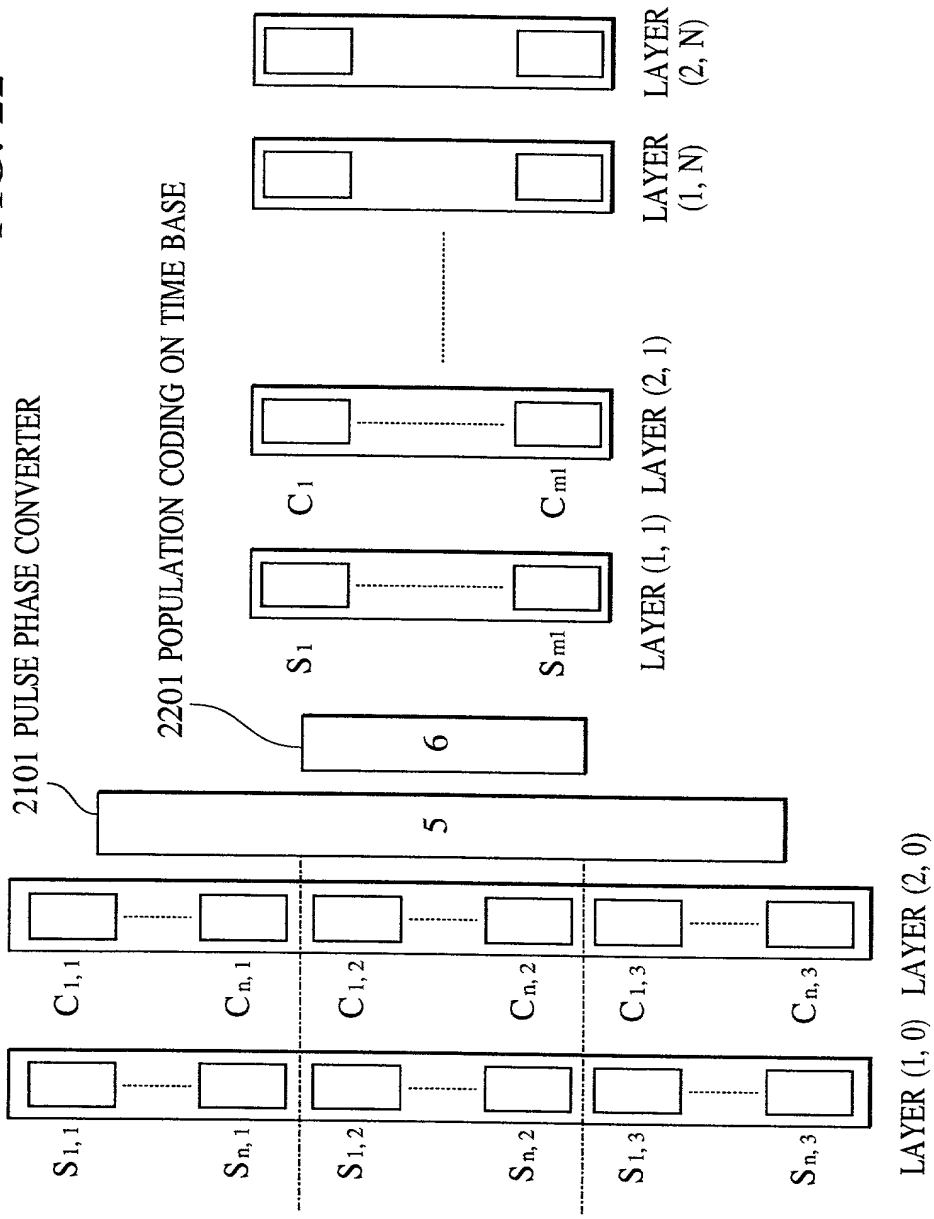
2101 PULSE PHASE CONVERTER
2201 POPULATION CODING ON TIME BASE
5
6
$S_{1,1}$
$S_{n,1}$
$S_{1,2}$
$S_{n,2}$
$S_{1,3}$
$S_{n,3}$
$C_{1,1}$
$C_{n,1}$
$C_{1,2}$
$C_{n,2}$
$C_{1,3}$
$C_{n,3}$
S_1
S_{m1}
C_1
C_{m1}
LAYER (1, 0)
LAYER (2, 0)
LAYER (1, 1)
LAYER (2, 1)
LAYER (1, N)
LAYER (2, N)

FIG. 23A

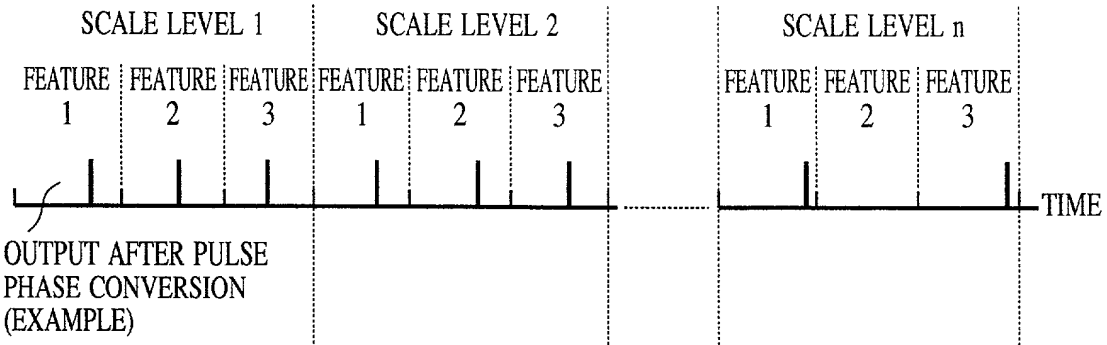

FIG. 23B

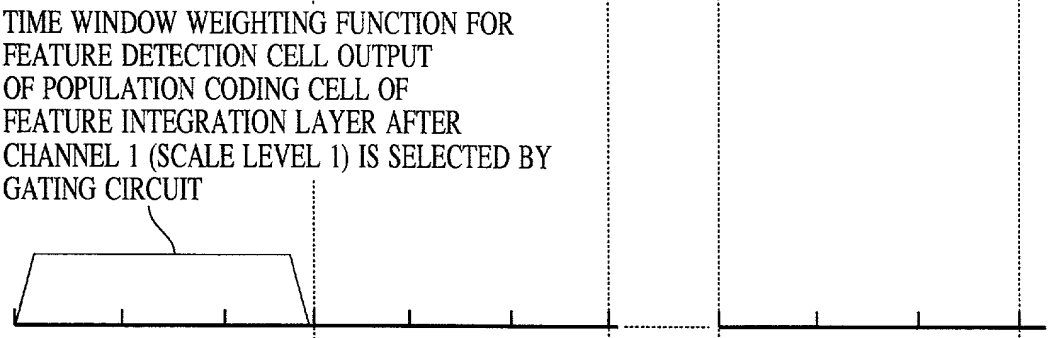

FIG. 23C

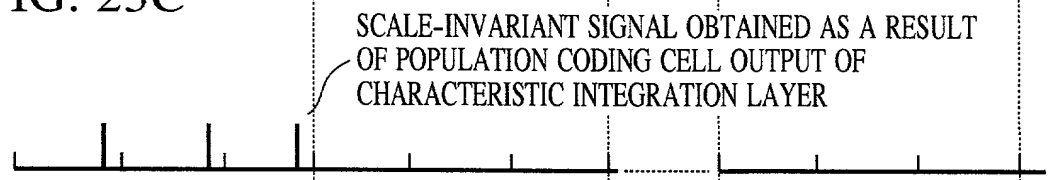

FIG. 23D

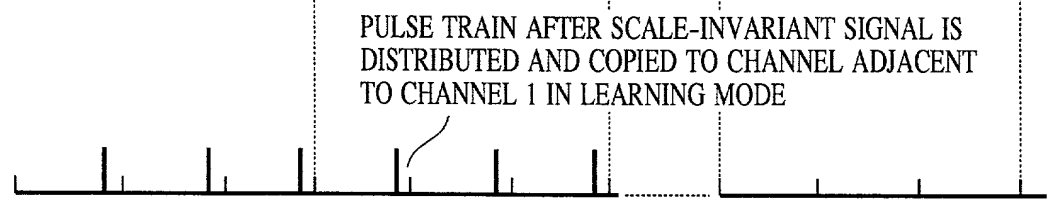

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FIG. 24A

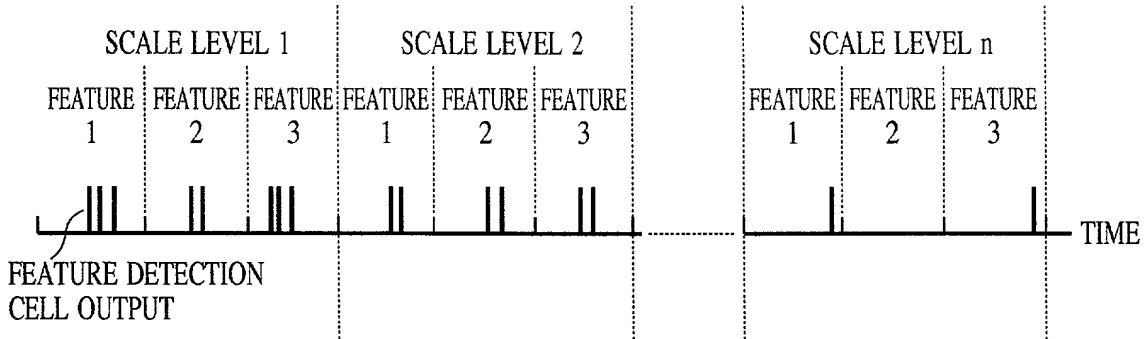

FIG. 24B

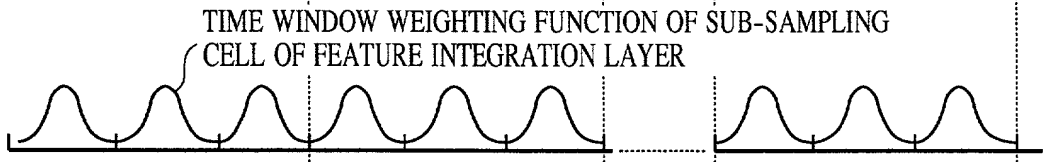

FIG. 24C

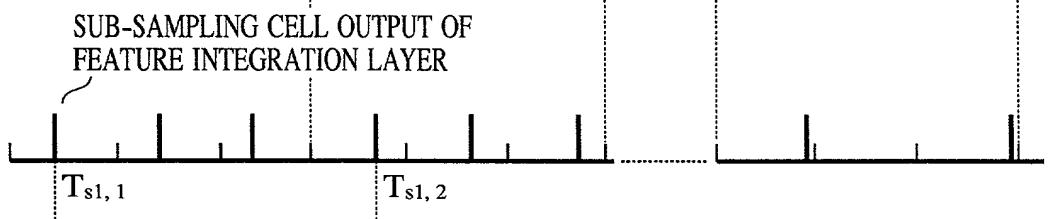

FIG. 24D

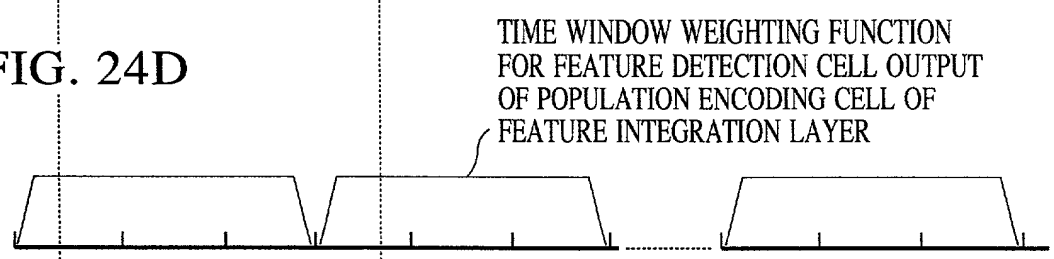

FIG. 24E

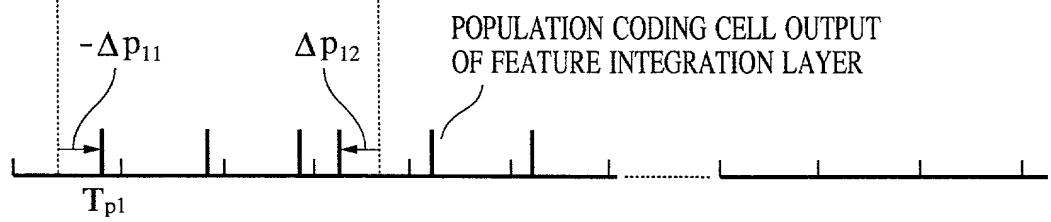

FIG. 25

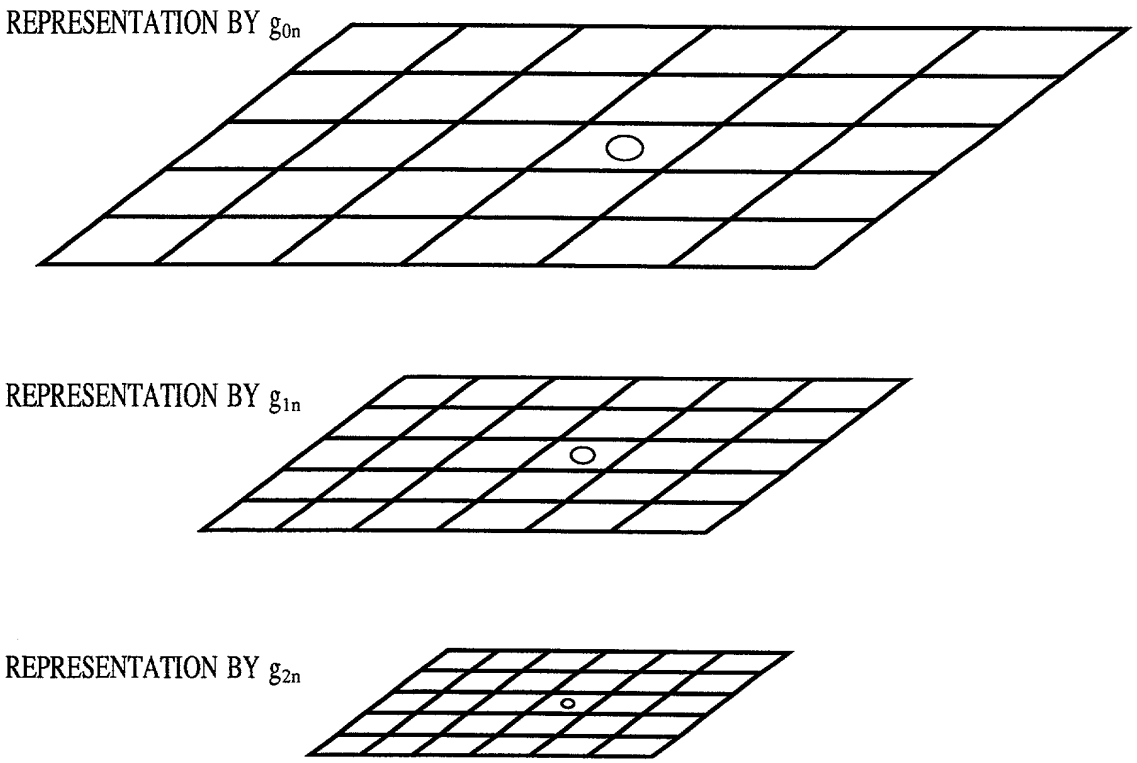

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FIG. 26

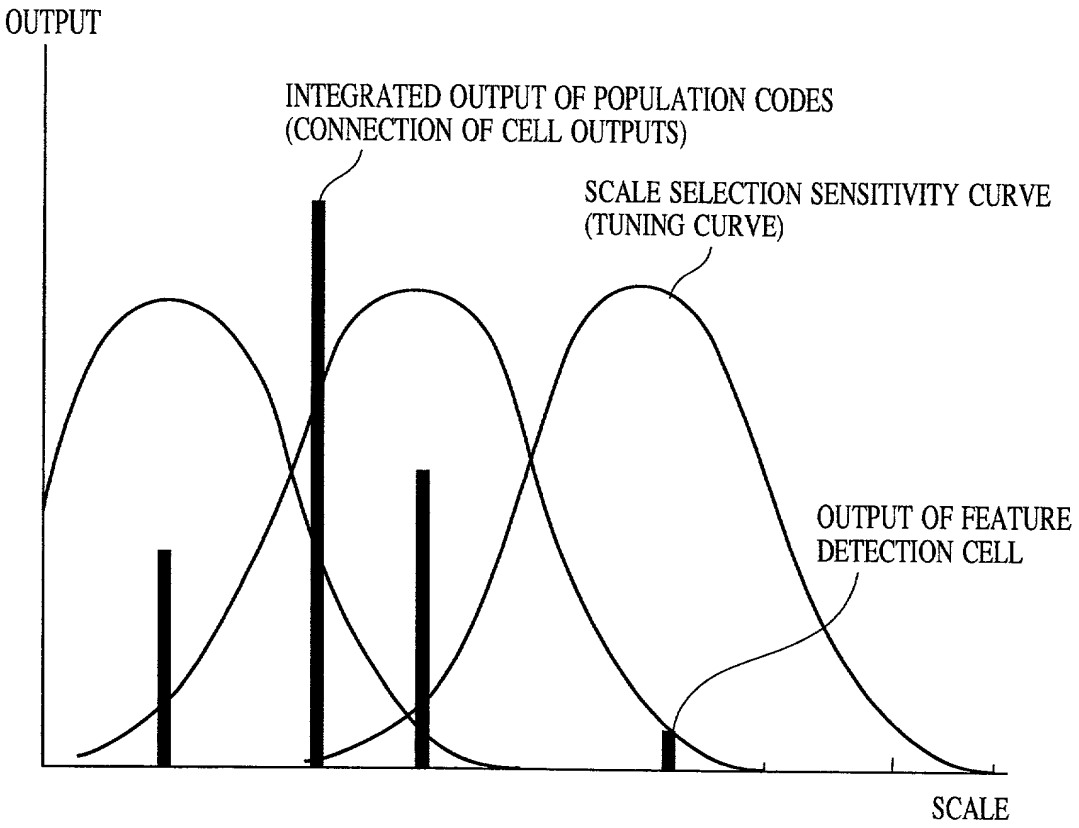

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FIG. 27

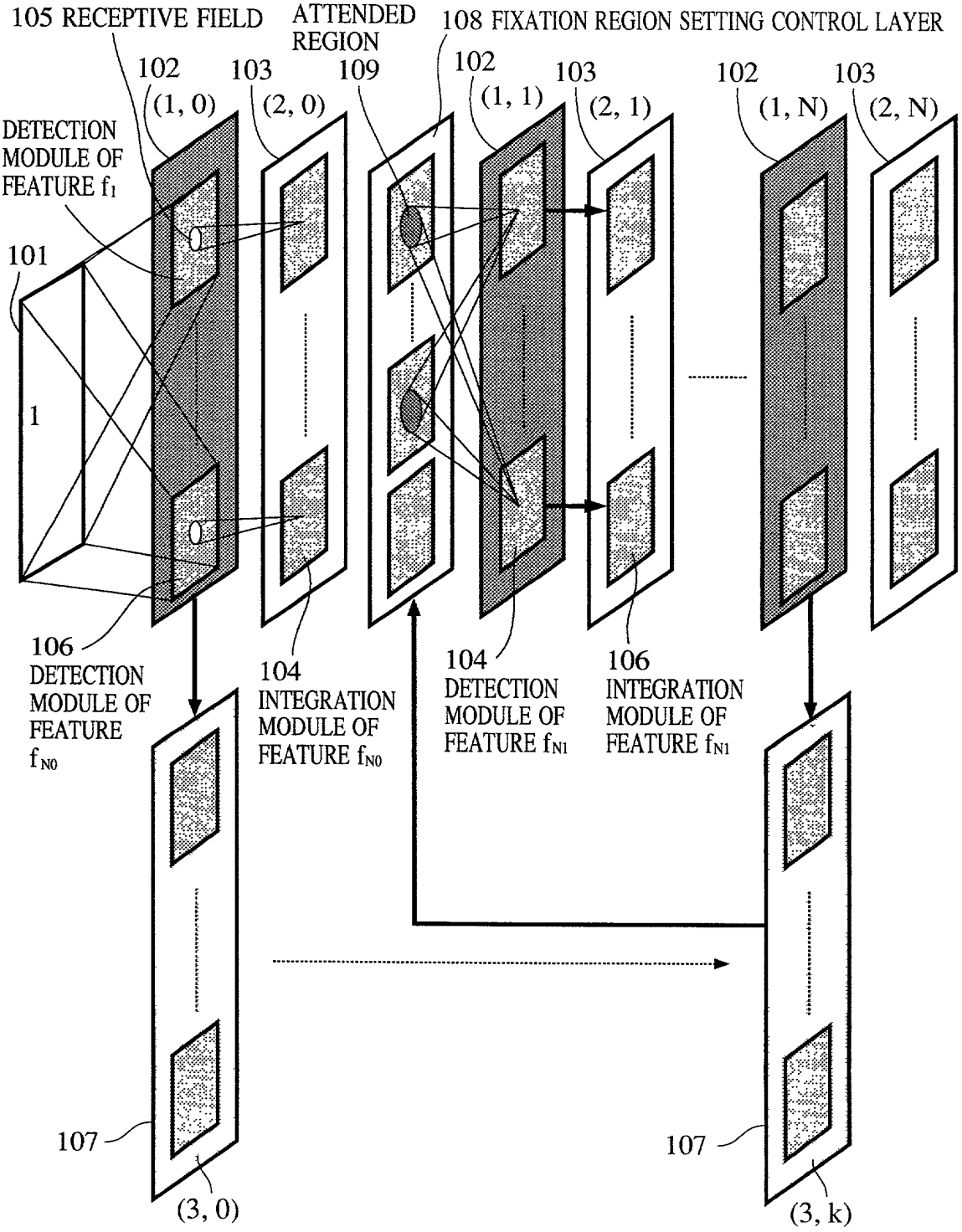

105 RECEPTIVE FIELD
ATTENDED REGION
108 FIXATION REGION SETTING CONTROL LAYER
102
103
109
(1, 0)
(2, 0)
(1, 1)
(2, 1)
(1, N)
(2, N)
DETECTION MODULE OF FEATURE f_1
101
1
0
0
106 DETECTION MODULE OF FEATURE f_{N0}
104 INTEGRATION MODULE OF FEATURE f_{N0}
104 DETECTION MODULE OF FEATURE f_{N1}
106 INTEGRATION MODULE OF FEATURE f_{N1}
107
(3, 0)
107
(3, k)

FIG. 28

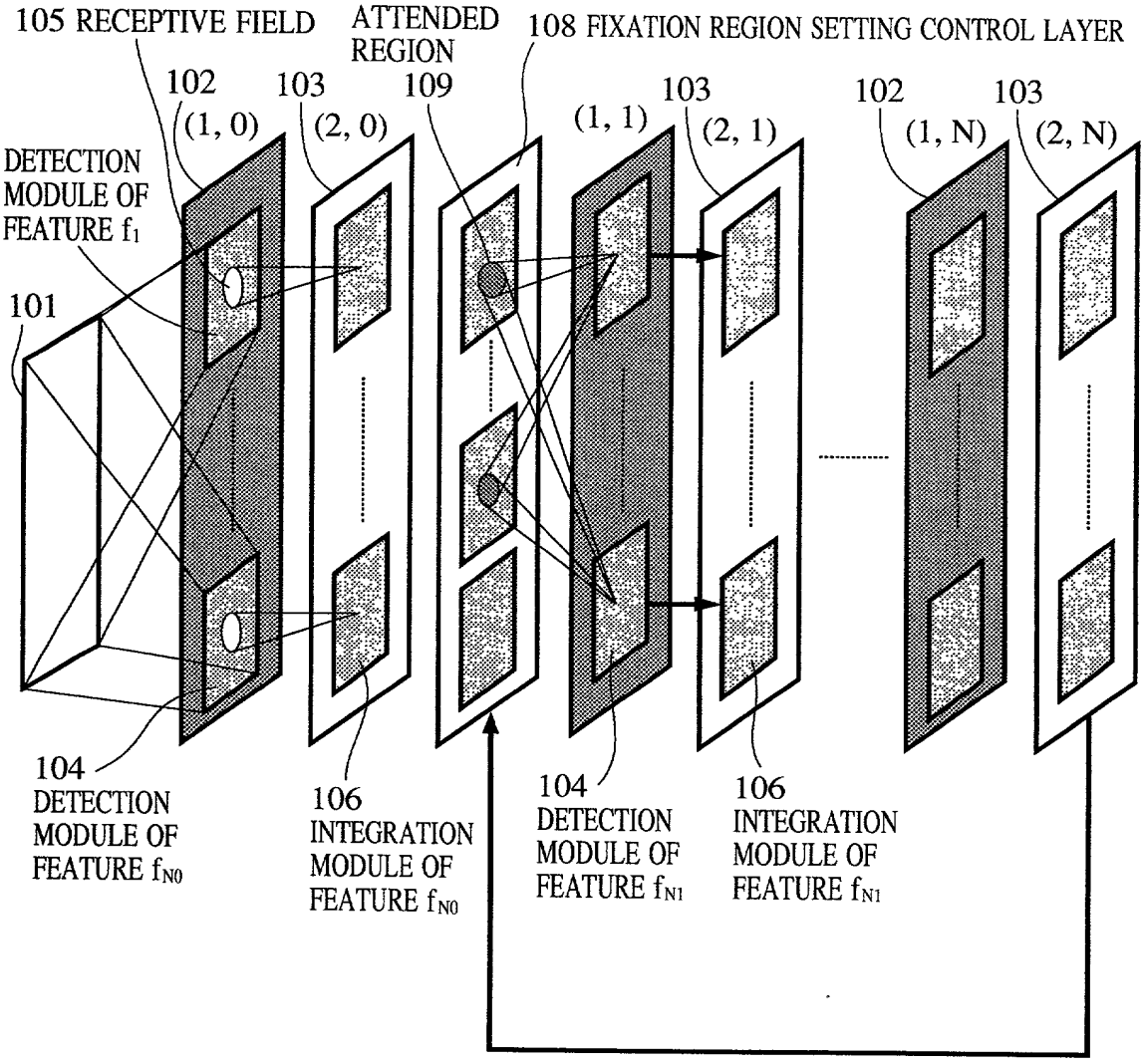

105 RECEPTIVE FIELD
ATTENDED REGION
108 FIXATION REGION SETTING CONTROL LAYER
102
(1, 0)
103
(2, 0)
109
(1, 1)
103
(2, 1)
102
(1, N)
103
(2, N)
DETECTION MODULE OF FEATURE f_1
101
104 DETECTION MODULE OF FEATURE f_{N0}
106 INTEGRATION MODULE OF FEATURE f_{N0}
104 DETECTION MODULE OF FEATURE f_{N1}
106 INTEGRATION MODULE OF FEATURE f_{N1}

FIG. 29

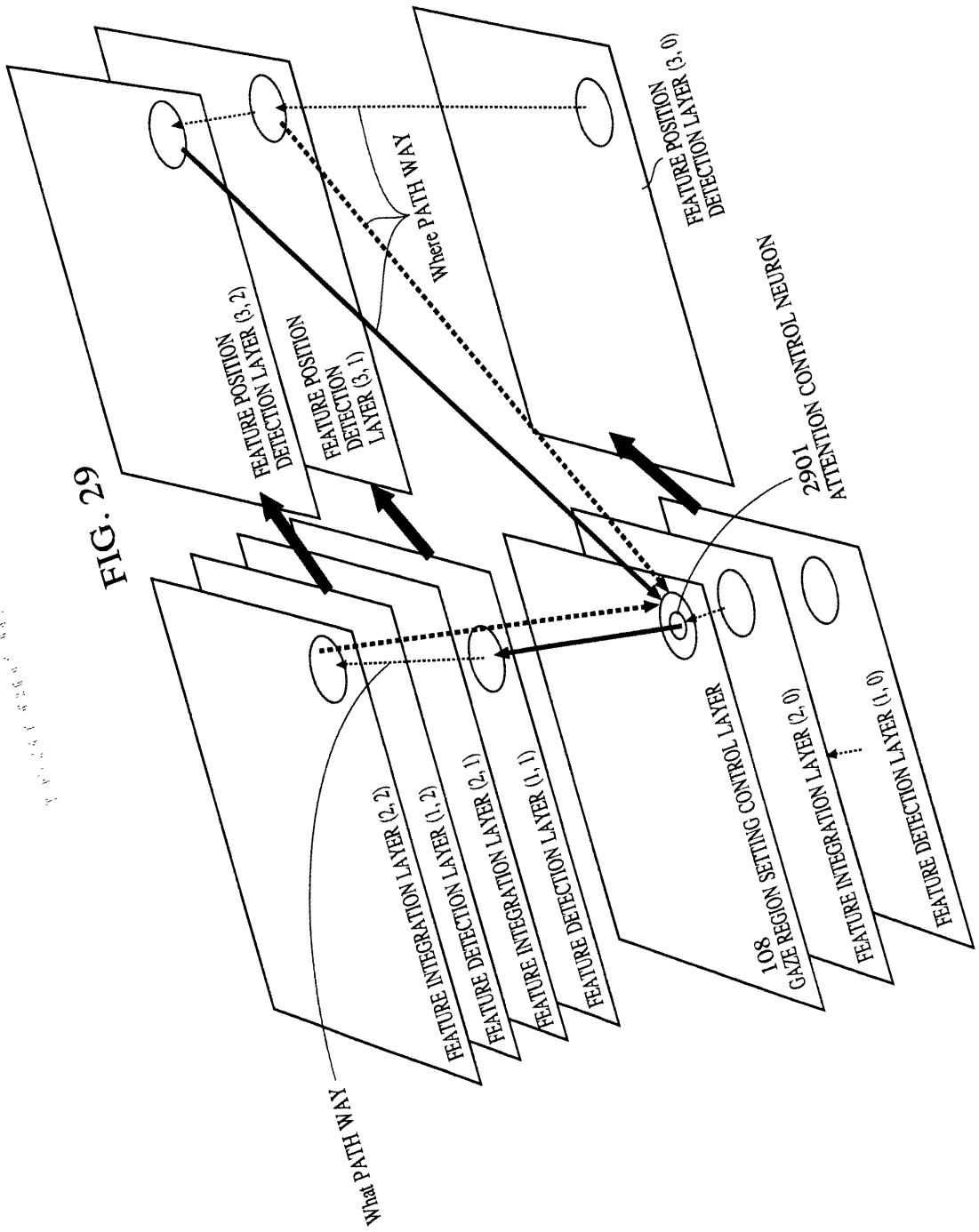

What PATH WAY
FEATURE INTEGRATION LAYER (2, 2)
FEATURE DETECTION LAYER (1, 2)
FEATURE INTEGRATION LAYER (2, 1)
FEATURE DETECTION LAYER (1, 1)
FEATURE DETECTION LAYER (1, 0)
FEATURE INTEGRATION LAYER (2, 0)
108
GAZE REGION SETTING CONTROL LAYER
2901
ATTENTION CONTROL NEURON
FEATURE POSITION DETECTION LAYER (3, 2)
FEATURE POSITION DETECTION LAYER (3, 1)
FEATURE POSITION DETECTION LAYER (3, 0)
Where PATH WAY

FIG. 30

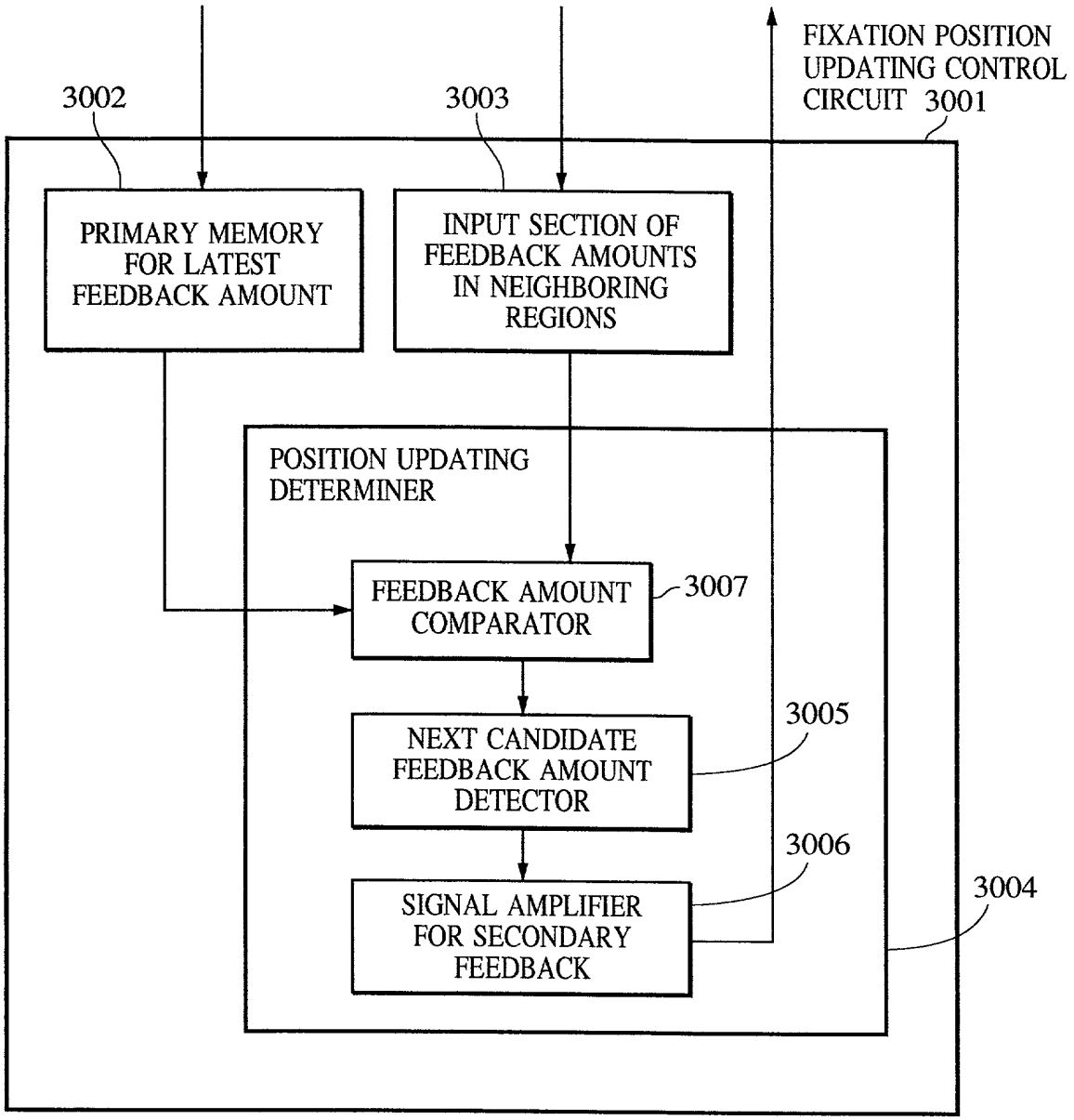

FIXATION POSITION UPDATING CONTROL CIRCUIT 3001
3002
3003
PRIMARY MEMORY FOR LATEST FEEDBACK AMOUNT
INPUT SECTION OF FEEDBACK AMOUNTS IN NEIGHBORING REGIONS
POSITION UPDATING DETERMINER
FEEDBACK AMOUNT COMPARATOR
3007
NEXT CANDIDATE FEEDBACK AMOUNT DETECTOR
3005
SIGNAL AMPLIFIER FOR SECONDARY FEEDBACK
3006
3004

FIG. 31

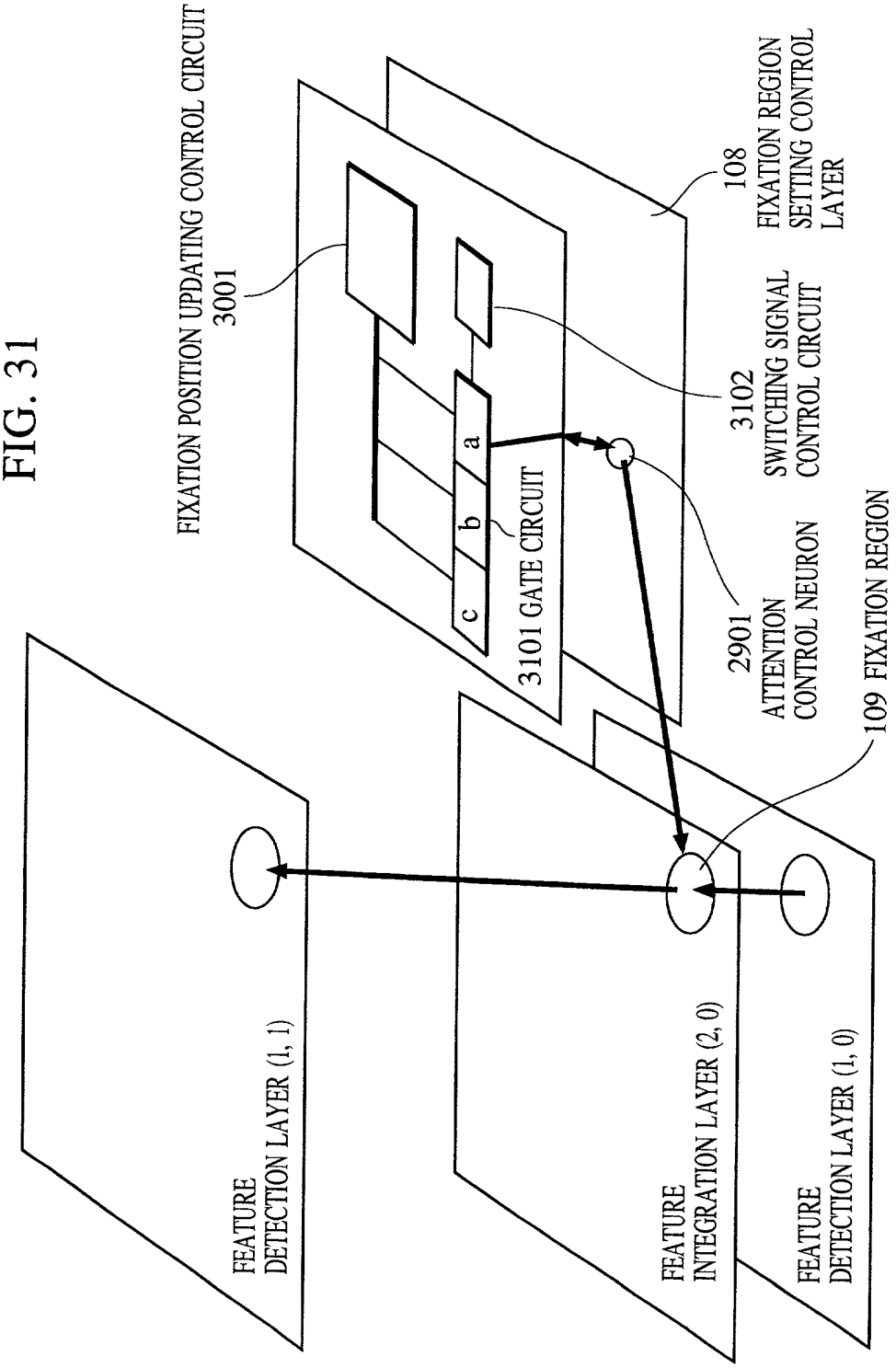

FIXATION POSITION UPDATING CONTROL CIRCUIT
3001
108
FIXATION REGION SETTING CONTROL LAYER
3102
SWITCHING SIGNAL CONTROL CIRCUIT
2901
ATTENTION CONTROL NEURON
3101 GATE CIRCUIT
a
b
c
109 FIXATION REGION
FEATURE DETECTION LAYER (1, 1)
FEATURE INTEGRATION LAYER (2, 0)
FEATURE DETECTION LAYER (1, 0)

FIG. 32

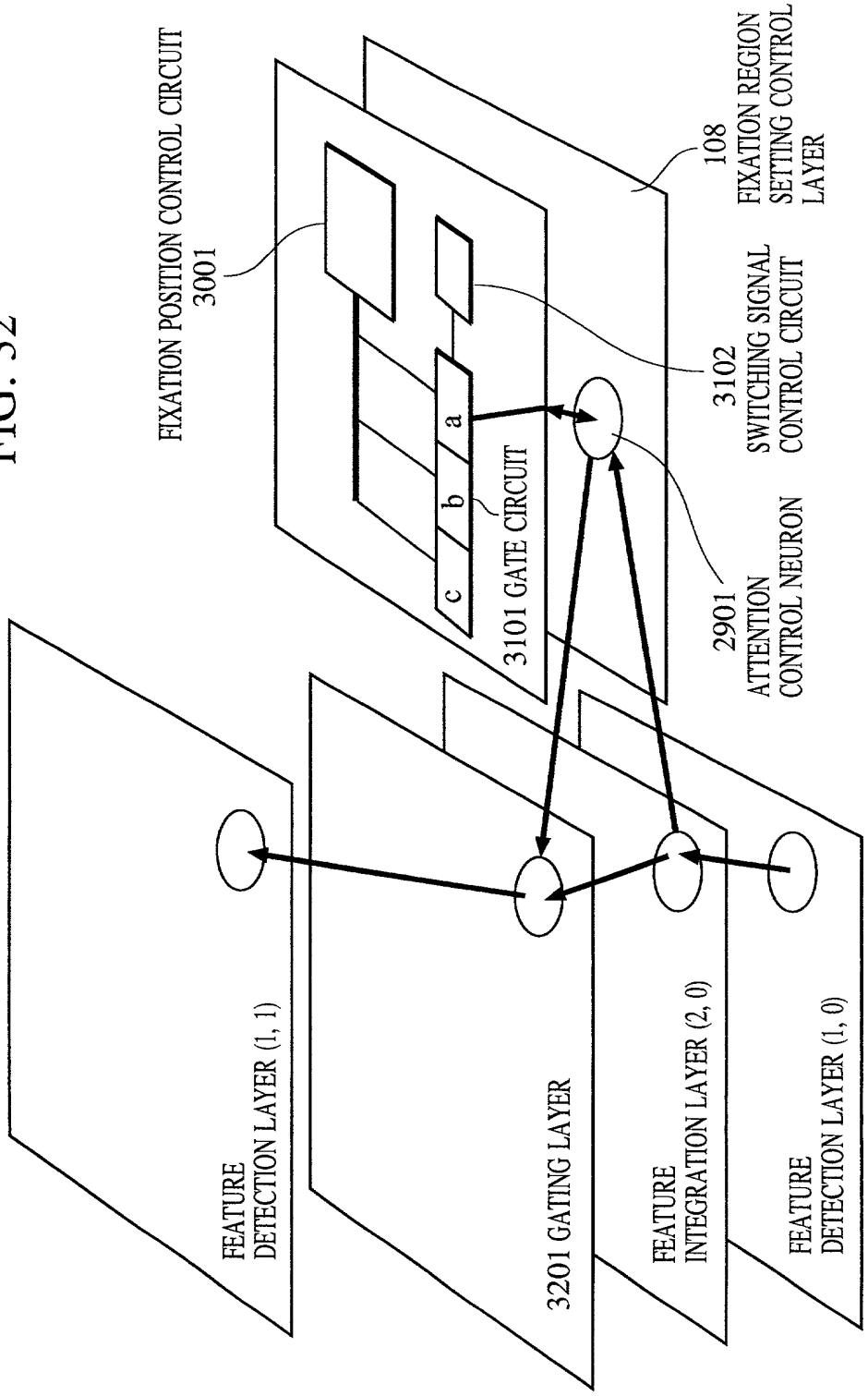

FIXATION POSITION CONTROL CIRCUIT
3001
108
FIXATION REGION SETTING CONTROL LAYER
3102
SWITCHING SIGNAL CONTROL CIRCUIT
2901
ATTENTION CONTROL NEURON
3101 GATE CIRCUIT
a
b
c
FEATURE DETECTION LAYER (1, 1)
3201 GATING LAYER
FEATURE INTEGRATION LAYER (2, 0)
FEATURE DETECTION LAYER (1, 0)

FIG. 33

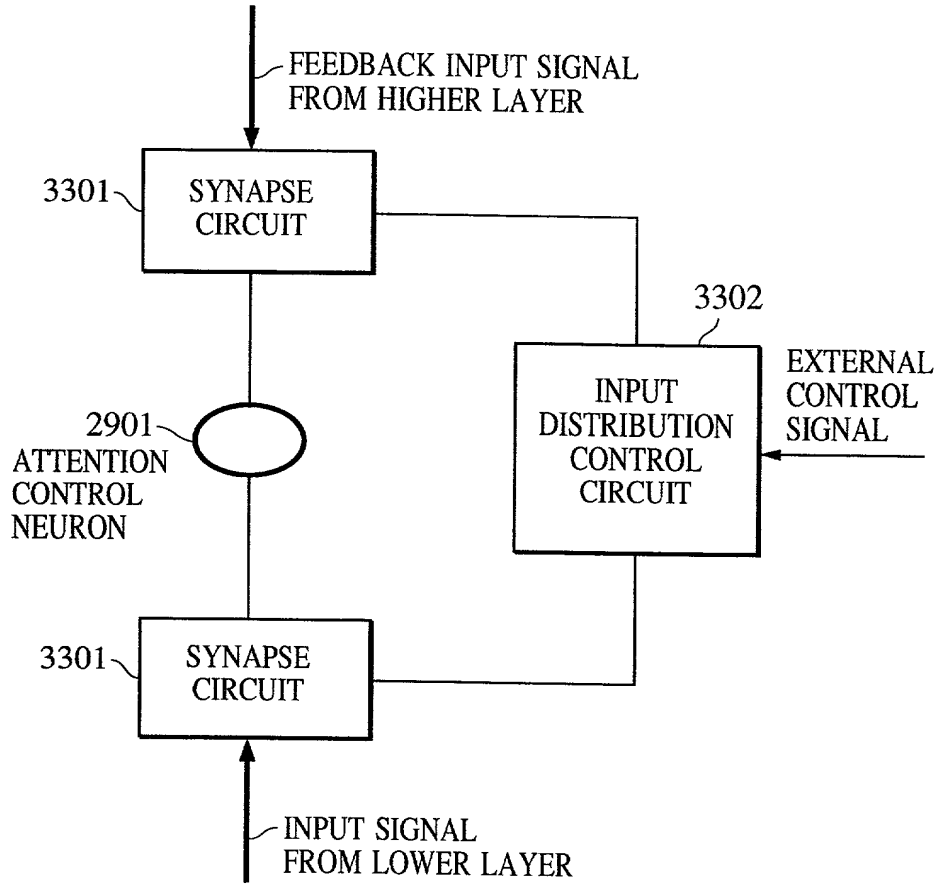

FEEDBACK INPUT SIGNAL
FROM HIGHER LAYER
3301
SYNAPSE
CIRCUIT
3302
INPUT
DISTRIBUTION
CONTROL
CIRCUIT
EXTERNAL
CONTROL
SIGNAL
2901
ATTENTION
CONTROL
NEURON
3301
SYNAPSE
CIRCUIT
INPUT SIGNAL
FROM LOWER LAYER

FIG. 34

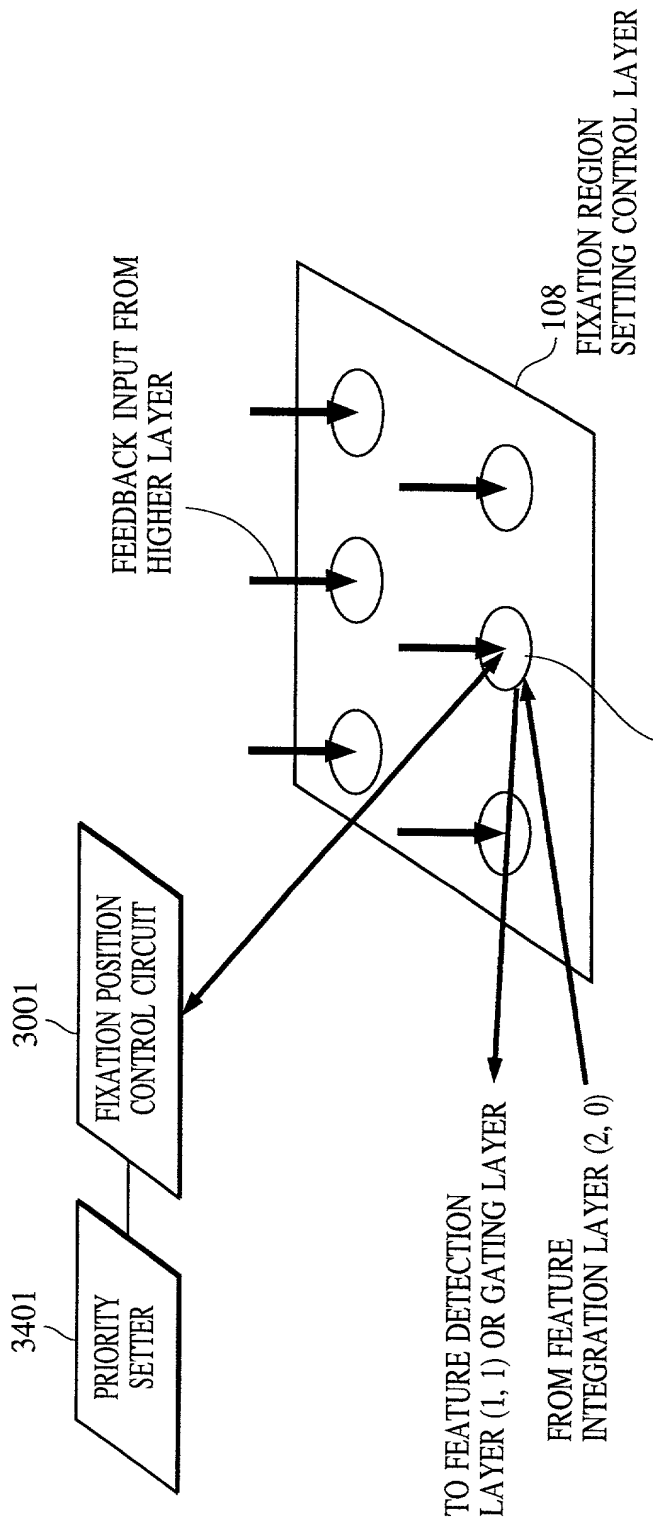

3401
PRIORITY SETTER
3001
FIXATION POSITION CONTROL CIRCUIT
FEEDBACK INPUT FROM HIGHER LAYER
108
FIXATION REGION SETTING CONTROL LAYER
2901 SELECTED ATTENTION CONTROL NEURON
TO FEATURE DETECTION LAYER (1, 1) OR GATING LAYER
FROM FEATURE INTEGRATION LAYER (2, 0)

FIG. 35

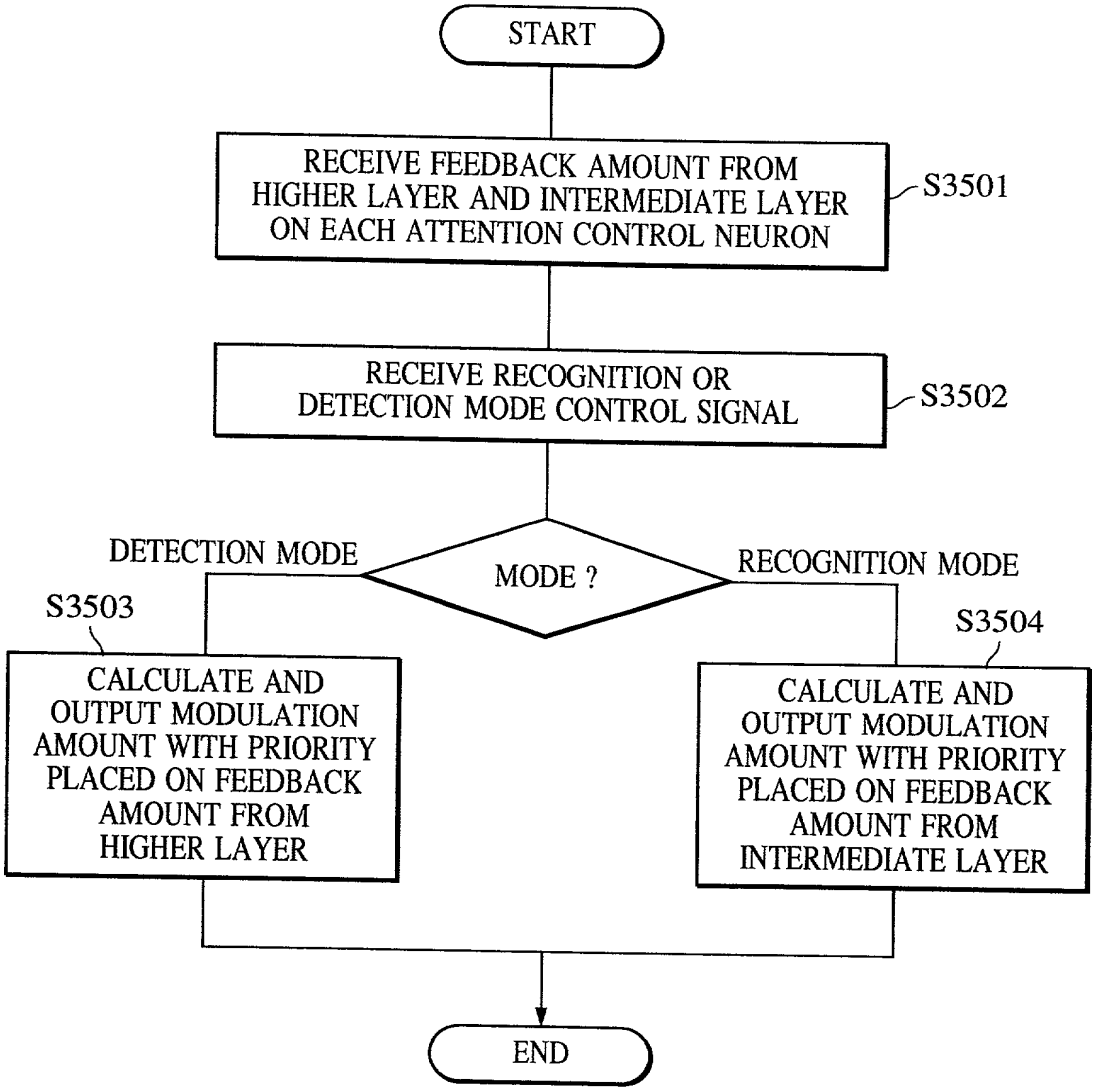

START
RECEIVE FEEDBACK AMOUNT FROM HIGHER LAYER AND INTERMEDIATE LAYER ON EACH ATTENTION CONTROL NEURON
S3501
RECEIVE RECOGNITION OR DETECTION MODE CONTROL SIGNAL
S3502
MODE ?
DETECTION MODE
RECOGNITION MODE
S3503
CALCULATE AND OUTPUT MODULATION AMOUNT WITH PRIORITY PLACED ON FEEDBACK AMOUNT FROM HIGHER LAYER
S3504
CALCULATE AND OUTPUT MODULATION AMOUNT WITH PRIORITY PLACED ON FEEDBACK AMOUNT FROM INTERMEDIATE LAYER
END

FIG. 36

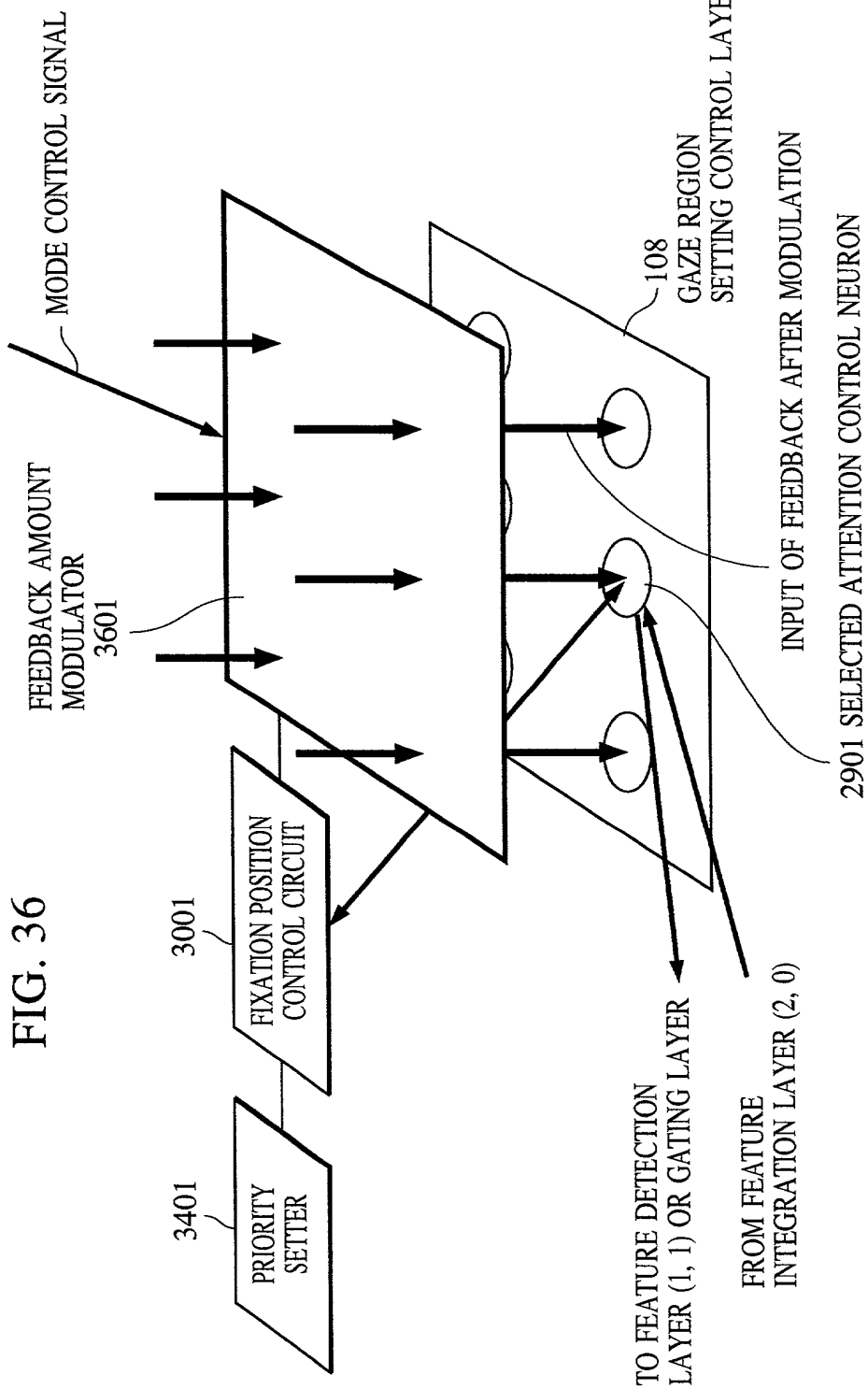

MODE CONTROL SIGNAL
FEEDBACK AMOUNT MODULATOR
3601
3001
FIXATION POSITION CONTROL CIRCUIT
3401
PRIORITY SETTER
108
GAZE REGION SETTING CONTROL LAYER
INPUT OF FEEDBACK AFTER MODULATION
2901 SELECTED ATTENTION CONTROL NEURON
TO FEATURE DETECTION LAYER (1, 1) OR GATING LAYER
FROM FEATURE INTEGRATION LAYER (2, 0)

FIG. 37

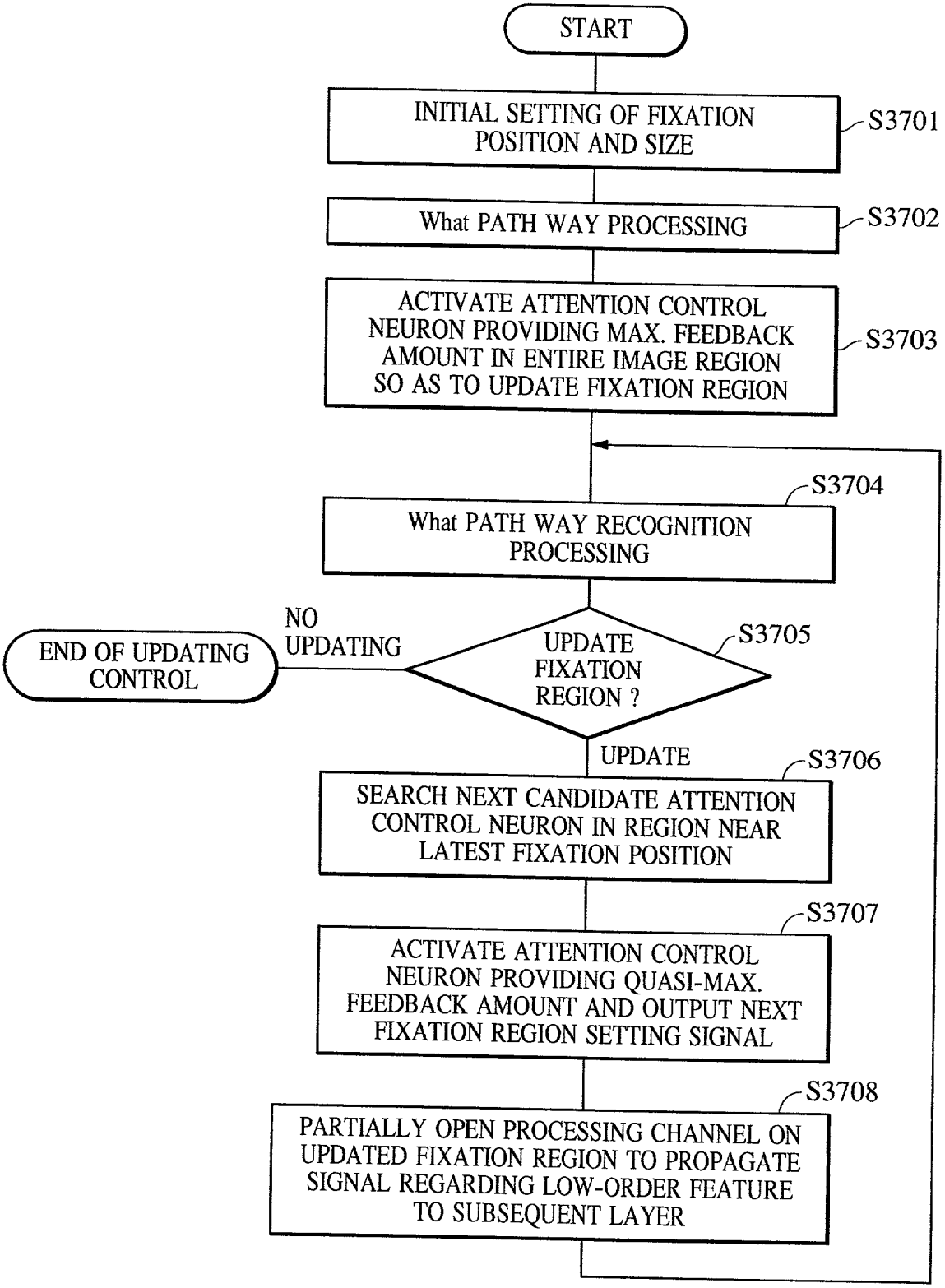

START
INITIAL SETTING OF FIXATION POSITION AND SIZE
S3701
What PATH WAY PROCESSING
S3702
ACTIVATE ATTENTION CONTROL NEURON PROVIDING MAX. FEEDBACK AMOUNT IN ENTIRE IMAGE REGION SO AS TO UPDATE FIXATION REGION
S3703
S3704
What PATH WAY RECOGNITION PROCESSING
UPDATE FIXATION REGION ?
S3705
NO UPDATING
END OF UPDATING CONTROL
UPDATE
S3706
SEARCH NEXT CANDIDATE ATTENTION CONTROL NEURON IN REGION NEAR LATEST FIXATION POSITION
S3707
ACTIVATE ATTENTION CONTROL NEURON PROVIDING QUASI-MAX. FEEDBACK AMOUNT AND OUTPUT NEXT FIXATION REGION SETTING SIGNAL
S3708
PARTIALLY OPEN PROCESSING CHANNEL ON UPDATED FIXATION REGION TO PROPAGATE SIGNAL REGARDING LOW-ORDER FEATURE TO SUBSEQUENT LAYER

FIG. 38

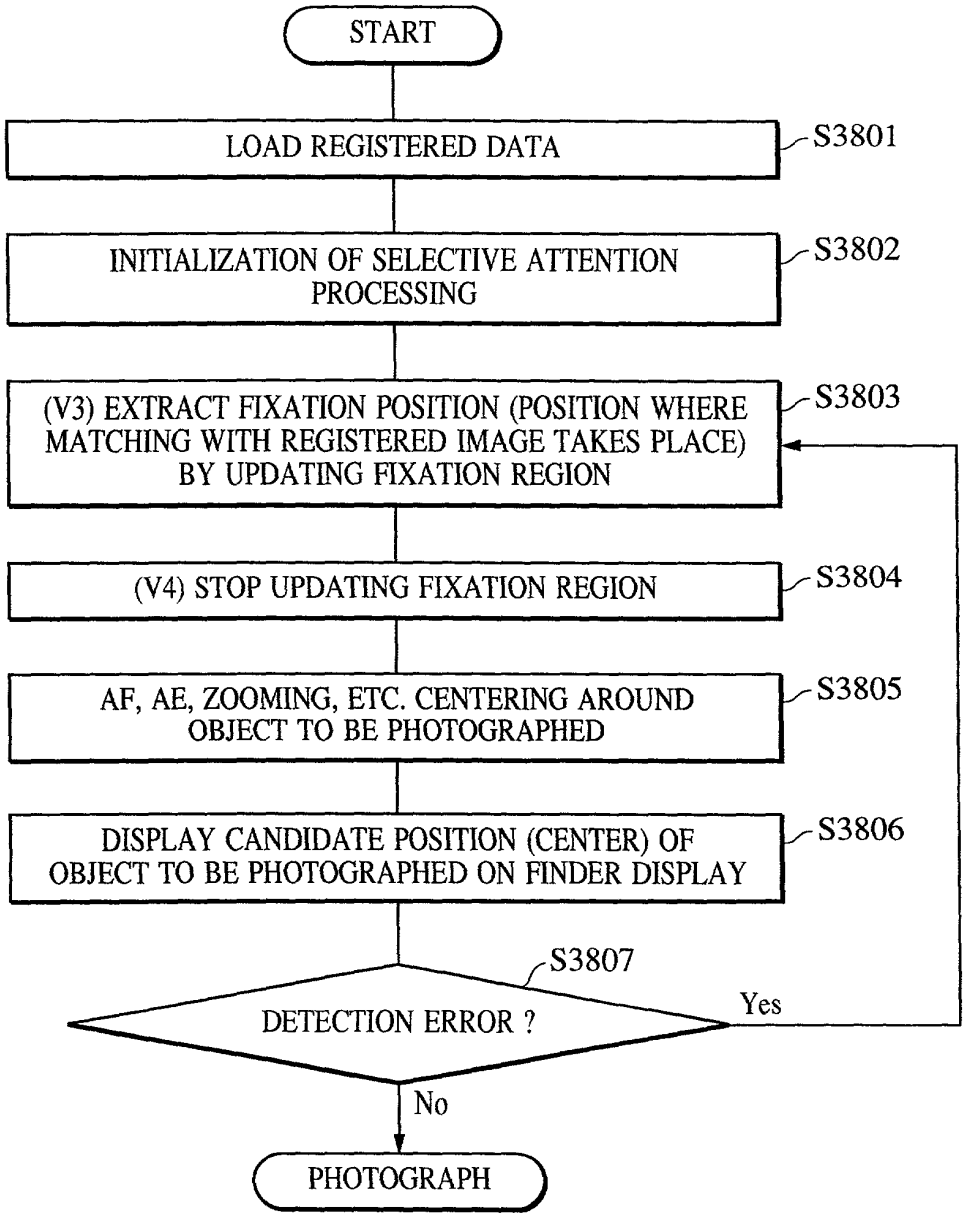
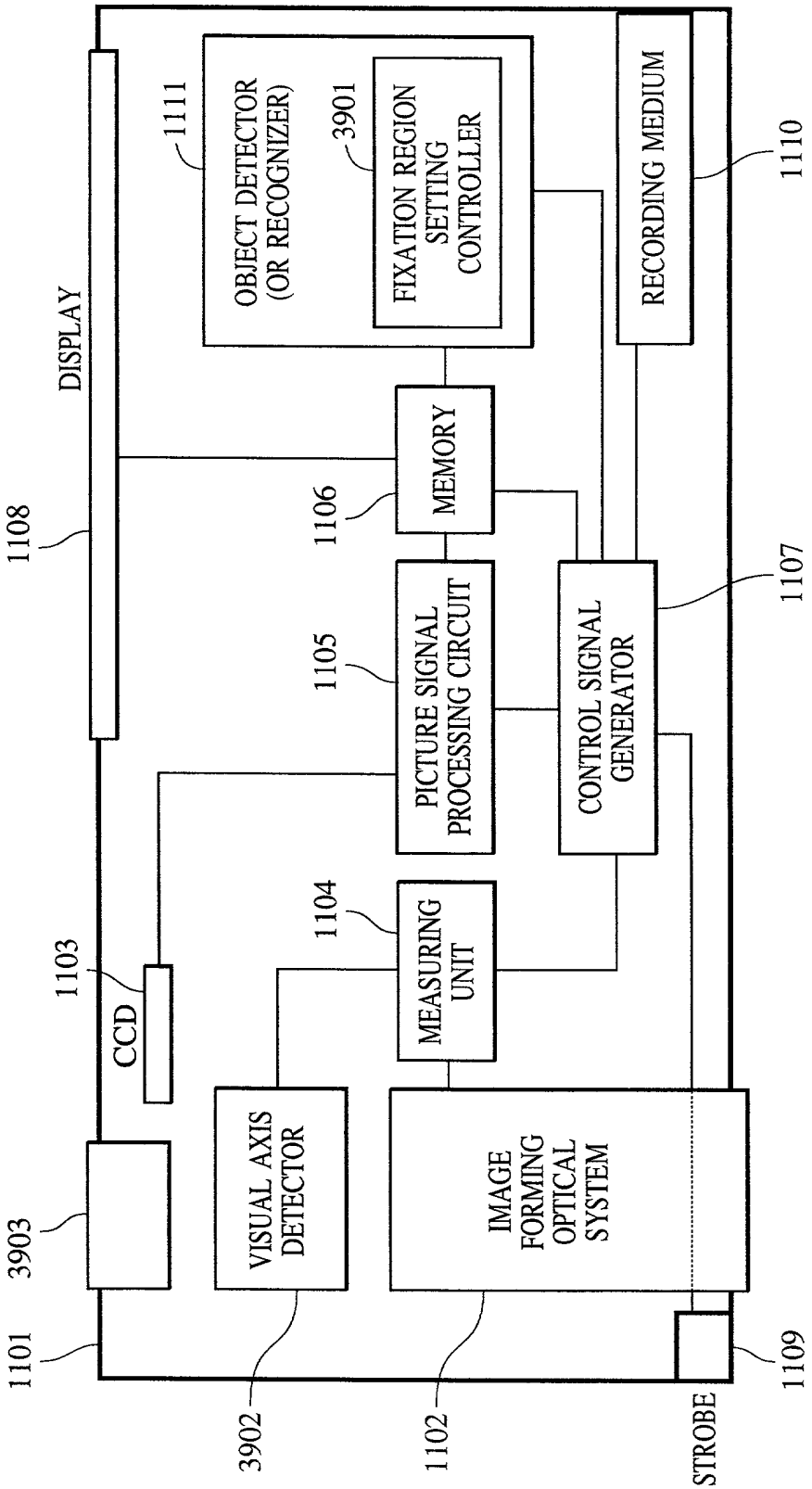

START
LOAD REGISTERED DATA
S3801
INITIALIZATION OF SELECTIVE ATTENTION PROCESSING
S3802
(V3) EXTRACT FIXATION POSITION (POSITION WHERE MATCHING WITH REGISTERED IMAGE TAKES PLACE) BY UPDATING FIXATION REGION
S3803
(V4) STOP UPDATING FIXATION REGION
S3804
AF, AE, ZOOMING, ETC. CENTERING AROUND OBJECT TO BE PHOTOGRAPHED
S3805
DISPLAY CANDIDATE POSITION (CENTER) OF OBJECT TO BE PHOTOGRAPHED ON FINDER DISPLAY
S3806
S3807
DETECTION ERROR ?
Yes
No
PHOTOGRAPH

FIG. 39


DISPLAY
1108
OBJECT DETECTOR (OR RECOGNIZER)
1111
FIXATION REGION SETTING CONTROLLER
3901
RECORDING MEDIUM
1110
MEMORY
1106
PICTURE SIGNAL PROCESSING CIRCUIT
1105
CONTROL SIGNAL GENERATOR
1107
CCD
1103
MEASURING UNIT
1104
VISUAL AXIS DETECTOR
IMAGE FORMING OPTICAL SYSTEM
3903
1101
3902
1102
STROBE
1109